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**FY 1994 Congressional Submission
RDT&E Descriptive Summaries**



April 1993

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences

Budget Activity: 1. Technology Base
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1992 Actual</u>	<u>FY 1993 Estimate</u>	<u>FY 1994 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
CCS-02	Information Sciences 44,816	49,175	33,677	Continuing	Continuing
ES-01	Electronic Sciences 26,568	34,791	31,853	Continuing	Continuing
MS-01	Materials Sciences 44,406	25,663	14,127	Continuing	Continuing
TOTAL	115,790	109,629	79,657	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF ELEMENT: The Defense Research Sciences program element provides the technical foundation for long-term improvements through the discovery of new phenomena and the exploration of the potential of such phenomena for military and commercial applications. It supports the scientific study and experimentation that is the base for more advanced knowledge and understanding in information, electronic and materials sciences. The programs contained in this Program Element reflect the Department's initiative to support dual-use technologies.

(U) The Information Sciences project focuses on advanced concepts in software technology, artificial intelligence, integration of intelligence technologies with manipulative systems in robotics, reliability and performance in microelectronic sciences, and varied aspects of High Performance Computing.

(U) The Electronic Sciences project explores and demonstrates electronic and optoelectronic device, circuit, and processing concepts to transmit, gather and process information at substantial increases in performance while realizing a considerable cost reduction.

(U) The Materials Sciences project concentrates on development of new materials for advanced composite structures, synthesis of efficient/heat resistant polymers, development of high power/energy density electrochemical power sources, disposal of toxic waste, and algorithms in Automatic Target Recognition to detect and identify targets hidden in foliage.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences

Project Number: CCS-02
Budget Activity: 1. Technology Base
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
CCS-02 Information Sciences	44,816	49,175	33,677	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: This project supports the scientific study and experimentation that is the basis for more advanced knowledge and understanding in Information Sciences related to long-term national security and commercial needs. Software technology, develops advanced concepts for methods and tools to produce high assurance software, language concepts that facilitate the rapid specification and evolution of systems, and techniques to manage shared complex structured data objects in design support systems. Intelligent systems technology focuses on advanced techniques for understanding spoken language, written text, and visual images. Robotics technology, produces advanced control systems, including the integration of visual recognition with manipulator systems. Microelectronic science calibrates fundamental concepts to produce reliable, testable, and high performance design. High Performance Computing (HPC) science generates concepts and methods for validating and verifying design components, and unique approaches to rapidly develop high performance libraries across multiple HPC architectures. This effort supports the Director of Defense Research and Engineering (DDR&E) thrust area, Technology for Affordability.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Determined effectiveness of auditory models for robust speech recognition in noise.
- (U) Demonstrated advanced programming language concepts for specifying aspects of software requirements and for rapid prototyping of complex software.
- (U) Demonstrated concept for developing highly assured software involving separate multiple system layers.
- (U) Demonstrated open architecture framework for integrating advanced software tools.
- (U) Developed highly efficient parallel algorithms for multiple generic computational tasks.
- (U) Completed development of "ControlShell" - a software system for dynamic robotic control.
- (U) Completed development of a common infrastructure for data storage, update and retrieval.

St-A, Auth: ARPA (Mr. James Fargo -
696-2393) telecon, 4 May 93 CB

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

PE Title: Defense Research Sciences

Project Number: CCS-02

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Demonstrated prototype language and runtime environment which operates on a conventional serial machine as well as a scalable parallel machine.
- (U) Demonstrated new algorithms using binary decision diagrams - the basis of logic synthesis systems.
- (U) Developed early theory of reliable networks that use the same area while providing significantly enhanced reliability.

(U) FY 1993 Planned Program:

- (U) Develop concept for language to specify software architecture and interconnection amongst modules in software systems.
- (U) Develop concepts for component-oriented approaches to large scale software systems.
- (U) Develop concepts to support reuse of aspects of systems architecture and design.
- (U) Develop a laboratory research environment for active vision and vision-guided navigation.
- (U) Conduct assessment of distributed object management technology in design applications.
- (U) Demonstrate close integration of object-oriented database and programming language technologies.
- (U) Collect corpora of annotated speech, and associated translations, to facilitate multilingual research.
- (U) Develop text translation database as test data for evaluation of document understanding systems.
- (U) Develop approaches combining model-based vision and neural networks.
- (U) Develop and disseminate a prototype of a persistent object base.
- (U) Develop tools that can verify adherence to formalized interface specifications, demonstrating them on standard protocols.
- (U) Demonstrate new fault tolerant interconnection techniques which can be implemented on scalable parallel systems.
- (U) Develop fundamental approaches to construct high performance libraries which allow execution across multiple applications.

(U) FY 1994 Planned Program:

- (U) Develop process model approaches for prototyping large scale software systems.
- (U) Develop means to specify functional aspects of individual reusable components.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PF Title: Defense Research Sciences

Project Number: CCS-02
Budget Activity: 1. Technology Base
Date: April 1993

- (U) Demonstrate active vision assisted manipulator task execution from mobile platform.
- (U) Establish evaluation metrics for multilingual speech systems.
- (U) Demonstrate rudimentary spoken language translation systems and document understanding systems.
- (U) Develop evaluation metrics for preliminary hybrid vision systems.
- (U) Validate the persistent object base to support rapid development of autonomous multilingual software capable of sharing information.
- (U) Develop fundamental design concepts and approaches needed to incorporate gigahertz technologies into computing architectures.
- (U) Demonstrate high performance libraries that can be constructed and executed on multiple scalable architectures.
- (U) Demonstrate fault tolerant and reliable network communication concepts in distributed systems.

D. (U) WORK PERFORMED BY: University of Southern California/ Information Sciences Institute, Marina del Rey, CA; Stanford University, Palo Alto, CA; Massachusetts Institute of Technology, Cambridge, MA; University of California at Berkeley, CA; and Carnegie Mellon University, Pittsburgh, PA.

E. (U) RELATED ACTIVITIES: The technologies developed in this Project provide the foundation for further developments in 0602301E, Computing Systems and Communications Technology.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Project Number: ES-01

PE Title: Defense Research Sciences

Budget Activity: 1. Technology Base

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1992 Actual</u>	<u>FY 1993 Estimate</u>	<u>FY 1994 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
ES-01	Electronic Sciences				
	26,568	34,791	31,853	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: This project explores and demonstrates electronic and optoelectronic device, circuit, and processing concepts that will provide; (1) new technical options for future electronic and optical systems used in information transmission, gathering and processing; and (2) a substantial increase in performance and cost reduction per function. Research areas include new electronic device and circuit concepts, innovative optical materials and devices, artificial neural network (ANN) research, fundamentally new semiconductor processing, and microelectromechanical systems (MEMS) technology. This basic research project creates the vital new concepts for advanced electronic, optoelectronic, and MEMS components to meet future Department of Defense (DoD) needs involving all the DDR&E thrust areas.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Fabricated integrated optical processing modules of photorefractive elements and electronic devices.
- (U) Formulated stable organic electro-optical polymers.
- (U) Integrated polymer waveguide devices with silicon very large scale integrated (VLSI) circuits.
- (U) Demonstrated long-wavelength infrared detector arrays with improved uniformity using low cost GaAs substrates at 60°K.
- (U) Investigated nearest neighbor interaction cellular automata architectures, using quantum devices.
- (U) Demonstrated logic elements using quantum devices.
- (U) Fabricated and demonstrated high-speed (> 1 billion operations/sec) neural net microchips.
- (U) Demonstrated neural network speech recognition and word spotting techniques.
- (U) Demonstrated nanoscale electrical probe.
- (U) Demonstrated artificial retina using nanoelectronics.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Project Number: ES-01

PE Title: Defense Research Sciences

Budget Activity: 1. Technology Base

Date: April 1993

(U) FY 1993 Planned Program:

- (U) Develop diode laser amplifier arrays.
- (U) Develop coupled, quantum-well optical switches.
- (U) Demonstrate blue-green diode laser.
- (U) Fabricate nonlinear polymer device structures with molecular beam epitaxy (MBE).
- (U) Develop neural network techniques for temporal processing, nonlinear adaptive filters, and synthesis of 3-D images from 2-D views.
- (U) Demonstrate low cost, long-wavelength infrared focal plane arrays operating at 77°K using low cost GaAs substrates.
- (U) Demonstrate feasibility of free-space optical interconnect.
- (U) Develop conformal printing, 3-dimensional machine technologies, and shared multi-project fabrication runs for the manufacturing of microelectro-mechanical systems (MEMS).
- (U) Determine the utility of indium phosphide (InP) heterojunction bipolar transistor (HBT) technology for very wide bandwidth analog-to-digital (A/D) converter applications.
- (U) Demonstrate quantum dots grown in nanochannel glasses.
- (U) Measure optical constants of III-V materials (GaAs, InP, and their alloys) as a function of temperature and strain.
- (U) Demonstrate nanoelectronic shift register.
- (U) Fabricate lateral resonant-tunneling device.

(U) FY 1994 Planned Program:

- (U) Explore multi-valued logic architectures for nanoelectronics.
- (U) Demonstrate self-assembled organic polymer-based 10-nanometer-long wires.
- (U) Demonstrate 10X reduction in ultra-low-power laser size.
- (U) Demonstrate optical interconnects for chip-to-chip and on-chip.
- (U) Demonstrate scanning tunneling microscope patterning on the nanoscale.
- (U) Develop semiconductor laser diodes with minimum relative intensity noise (RIN) for analog modulation.
- (U) Investigate charge transport across quantum well interface for high speed operation.
- (U) Investigate crystalline and quantum well nonlinear polymer devices.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Project Number: ES-01

PE Title: Defense Research Sciences

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Initiate development of hybrid architectures, composed of neural net and conventional techniques, for application to image and speech recognition.
- (U) Demonstrate increased functional density using hybrid resonant tunnel diode and heterojunction bipolar transistor (HBT) circuits.
- (U) Initiate effort to explore abstraction concepts for the synthesis of semiconductor processes.
- (U) Develop formalism for describing unit processes and integrating process flows.
- (U) Develop microsensor CAD/CAM and process simulation tools and initiate multi-project, common fabrication infrastructure.
- (U) Begin development of massively parallel high-density read/write positioning microactuators for ultra-high density data storage.

D. (U) WORK PERFORMED BY: Stanford University, Palo Alto, CA; California Institute of Technology, Pasadena, CA; Texas Instruments, Dallas, TX; Martin-Marietta Labs, Baltimore, MD; Hughes Research Laboratory, Malibu, CA; Yale University, New Haven, CT; Lincoln Laboratory, Lexington, MA; Mayo Foundation, Rochester, MN; Massachusetts Institute of Technology, Cambridge, MA; Optivision, Palo Alto, CA; Rockwell International Science Center, Thousand Oaks, CA; and AT&T Bell Labs, Holmdel, NJ.

E. (U) RELATED ACTIVITIES: Efforts in this project are coupled to the Services' program through use of Service agents, annual DoD-wide program reviews, and review by the Advisory Group on Electron Devices (AGED). These activities assure that no unnecessary duplication of effort occurs. This project provides a research base for 62712E, MPT-02, Electronics Processing Technology.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences

Project Number: MS-01
Budget Activity: 1. Technology Base
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
MS-01					
Materials Sciences					
	44,406	25,663	14,127	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: This project is concerned with the development of new materials and concepts for advanced composite structures; synthesis of stronger and more heat resistant polymers; exploitation of biologically-derived materials such as electron source structures, magnetic composite materials and advanced spatial light modulators; development of high power/energy density electrochemical power sources. Other areas of focus are research into the disposal of toxic chemical wastes and waste source reduction for DoD relevant manufacturing processes; development of advanced algorithms and associated technologies for detecting and identifying targets hidden in foliage; and advanced signal processing algorithms to improve unattended ground sensor (UGS) performance.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Demonstrated rapid process for manufacture of small diameter boron nitride fibers.
- (U) Produced and delivered 25 solid state batteries for performance testing.
- (U) Determined the electrostrictive properties of polyurethane films and demonstrated the possibility of developing an advanced sonar.
- (U) Initiated work on supercritical water oxidation for the safe destruction of toxic military wastes.
- (U) Assembled and tested a platinum/ruthenium alloy catalyst direct methanol fuel cell producing the highest direct methanol cell data reported to date.
- (U) Initiated a program for the avoidance/elimination of toxic waste production as by-products of DoD-related manufacturing processes.
- (U) Demonstrated for the first time the fabrication of continuous fiber ceramic matrix composites with fiber coatings that successfully improve high temperature toughness.
- (U) Initiated team effort to develop manufacturable processes for high temperature superconducting

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences

Project Number: MS-01
Budget Activity: 1. Technology Base
Date: April 1993

interconnects in multi-chip modules, to be applied to
electronic-warfare systems in military avionics.

(U) FY 1993 Planned Program:

- (U) Optimize processing of boron nitride fiber for composite material reinforcement.
- (U) Complete performance testing of solid state batteries previously delivered in FY 1992.
- (U) Initiate contracts for toxic waste source reduction for DoD relevant manufacturing processes.
- (U) Complete thermo mechanical testing of high temperature polymer composite coupons.
- (U) Produce prototype primary solid state battery.
- (U) Initiate construction of pilot plant for safe destruction of toxic military chemical wastes.
- (U) Develop novel methods for automatic target recognition and classification using wavelets, a new signal representation method, and other advanced mathematical techniques.
- (U) Develop procedures for optimization of complementary metal oxide semiconductor (CMOS) chips for operation at 80°K, without substantially changing fabrication procedures (i.e., variations in implant density and depth).
- (U) Initiate a program to develop elevated temperature operation of laser diodes to pump solid state lasers and two micron laser sources for infrared countermeasures.
- (U) Investigate signal clutter adaptive detection algorithms for locating targets in deep-hide.

(U) FY 1994 Planned Program:

- (U) Demonstrate high efficiency direct oxidation fuel cell power module.
- (U) Demonstrate prototype rechargeable solid state military battery.
- (U) Construct supercritical water oxidation processor for destruction of toxic wastes.
- (U) Demonstrate benefits of damage tolerant monolithic structural ceramics with fiber composite laminate surface layers.
- (U) Initiate a program to develop a logistic fuel cell for mobile electric power.
- (U) Initiate program in medical technology concerned with developing medical sensors and the use of advanced information technologies to enhance battlefield trauma care.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E
PE Title: Defense Research Sciences

Project Number: MS-01
Budget Activity: 1. Technology Base
Date: April 1993

D. (U) WORK PERFORMED BY: University of Pennsylvania, Philadelphia, PA; Massachusetts Institute of Technology, Cambridge, MA; California Institute of Technology, Pasadena, CA; Lanxide Corporation, Newark, DE; GA Technologies, La Jolla, CA; University of California, Santa Barbara, CA; International Fuel Cells, South Windsor, CT; Owens Corning Fiberglass, Granville, OH; University of Illinois, Urbana, IL; E-Systems, Greenville, TX; nChip, Sunnyvale, CA; Cornell University, Ithaca, NY; E-Systems, Falls Church, VA; University of Arkansas, Fayetteville, AK; Texas Instruments, Dallas, TX; Northwestern University, Evanston, IL; and Georgia Institute of Technology, Atlanta, GA.

E. (U) RELATED ACTIVITIES: ARPA's research in Materials Sciences is coordinated within the DoD and with other federal agencies via the National Science Foundation-hosted Interagency Materials Group, Office of Science and Technology Policy (OSTP) Committee on Materials (COMAT), and various Director Defense Research and Engineering (DDR&E) sponsored topical workshops on advanced materials. These activities assure that no unnecessary duplication of effort occurs.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Budget Activity: 1. Technology Base

PE Title: Computing Systems and
Communications Technology

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
ST-01	JASON 1,300	1,240	1,240	Continuing	Continuing
ST-10	Strategic Computing 79,106	68,234	0	0	Transferred to ST-11 and ST-19
ST-11*	Intelligent Systems and Software 31,689	38,831	68,841	Continuing	Continuing
ST-12*	Advanced Quantum Electro-Optics and Electronic Warfare 11,768	8,618	0	0	Transferred to TT-06
ST-15	Gallium Arsenide 7,154	0	0	0	136,970
ST-16*	High Temperature Superconductivity/Ceramics 26,446	0	0	0	Transferred to MPT-06
ST-18	DARPA Initiative in Concurrent Engineering (DICE) 20,000	0	0	0	47,135
ST-19	High Performance Computing (HPC) 110,829	134,388	237,926	Continuing	Continuing
ST-20*	Distributed Information Systems/C ³ (33,993)	34,352	0	0	Transferred to ST-11
ST-21*	Software Engineering Institute (SEI) (27,100)	15,635	0	0	Transferred to ST-22
ST-22*	Software Engineering Technology (25,217)	21,814	39,096	Continuing	Continuing
ST-23*	Surveillance Research (19,466)	26,351	21,486	Continuing	Continuing
TOTAL	288,292	349,463	368,589		

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Budget Activity: 1. Technology Base

PE Title: Computing Systems and
Communications Technology

Date: April 1993

*These projects reflect the Program Element/Project consolidation and realignment within ARPA. FY 1992 funding in parentheses is shown for continuity purposes and does not add to total.

B. (U) BRIEF DESCRIPTION OF ELEMENT/PROJECT: This program element funds projects directed toward the application of advanced, innovative computing systems and communications technologies. These programs include:

(U) ARPA leadership of the Federal High Performance Computing and Communications Initiative to develop technologies to allow computer systems to function at a trillion operations per second.

(U) Software engineering to provide fundamentally new software capabilities and expand the application of artificial intelligence.

(U) Software Engineering Institute (SEI) and Software Technology for Adaptable, Reliable Systems (STARS). SEI works to transition, introduce and promulgate modern software in the defense industry. STARS work to develop large-scale software products that have commercial as well as military capabilities.

(U) The surveillance research and anti-nuclear proliferation project enhances U.S. capabilities to globally monitor nuclear explosions, and to detect production, testing, and storage of nuclear material and weapons.

(U) The JASON studies effort to support the National Security Community.

(U) The programs contained in Projects ST-11, ST-19 and ST-22 reflect the Department's initiative to support dual-use technologies.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: <u>#0602301E</u>	Project Number: <u>ST-01</u>
PE Title: <u>Computing Systems and</u>	Budget Activity: <u>1. Technology Base</u>
<u>Communication Technology</u>	Date: <u>April 1993</u>

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
ST-01 JASON	1,300	1,240	1,240	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: This project supports the JASONS, an independent group of distinguished individuals dedicated to sophisticated scientific and technical research and analysis in support of the National Security Community. JASON membership is carefully balanced to provide a wide spectrum of scientific expertise and technical analysis in theoretical and experimental physics, materials, information sciences, and other allied disciplines.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Conducted investigations involving: structural acoustics; advanced land combat vehicles; precision strike; ASW; nuclear weapon proliferation; and global surveillance and communications.

(U) FY 1993 Planned Program:

- (U) Conduct extensive technical investigations in areas such as: advanced sensors for surveillance and strike; shallow water acoustic ASW; advanced concepts for lightweight survivable combat vehicles; advanced materials; and signal processing.

(U) FY 1994 Planned Program:

- (U) Continue investigations in technical problems related to the ARPA mission of supporting the Services with the development of advanced technologies, including new approaches to stealth, surveillance, communications and signal processing.

D. (U) WORK PERFORMED BY: MITRE Corporation, McLean, VA supports the JASON group.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-01

PE Title: Computing Systems and
Communication Technology

Budget Activity: 1. Technology Base

Date: April 1993

E. (U) RELATED ACTIVITIES: Not applicable.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Project Number: ST-11
PE Title: Computing Systems and Budget Activity: 1. Technology Base
 Communications Technology Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
ST-11 Intelligent Systems and Software	31,689	38,831	68,841	Continuing	Continuing

As part of the consolidation and realignment of program elements and projects within ARPA, a portion of the Strategic Computing (Project ST-10) funding was transferred to ST-11 in FY 1994 and outyears. In FY 1994, \$34,939K was transferred.

B. (U) BRIEF DESCRIPTION OF PROJECT: This project develops new science and technology concepts that lead to fundamentally new software capabilities and intelligent information processing approaches. This will enable computers to augment military personnel performing tactical decision-making tasks in stressful, time sensitive situations; create efficient software systems supporting computer and software intensive defense systems; and develop advanced software technology.

(U) Major areas of technical emphasis are in (a) software development technology including languages, algorithms, data and object bases, domain specific software architectures, software prototyping technology, software design tools, software reuse, and advanced software engineering environments; (b) intelligent systems (artificial intelligence) including autonomous systems, interactive problem solving; and intelligent integration of information from heterogeneous sources; and (c) manufacturing automation and design engineering include the development of advanced software systems which support sharing of engineering knowledge, advanced product and process design representations, integrated product and process design, software tools for design process management, manufacturing process planning, manufacturing process control, and demonstrations.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Developed standards to facilitate reuse of AI methods and knowledge bases.
- (U) Develop common image understanding.
- (U) Developed consensus derived software architectures.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-11

PE Title: Computing Systems and
Communications Technology

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Demonstrated new AI tools in very large scale distributed experiments.
 - (U) Demonstrated a large-scale interactive knowledge-based transportation planning aid.
 - (U) Developed a robust road-sign recognition and planning system.
 - (U) Completed fielding of 50 Dynamic Analysis and Replanning Tool (DART) planning systems to 14 military commands.
 - (U) Developed prototype implementation of high-level language to support rapid software prototyping.
 - (U) Demonstrated capabilities of simulated and virtual factory for semiconductor process design.
 - (U) Developed autonomous navigation capabilities on surrogate semi-autonomous vehicles.
 - (U) Demonstrated, in laboratory setting, a software architecture supporting multi-disciplinary design, analysis, manufacturing and engineering.
 - (U) Evaluated performance of prototyping languages.
 - (U) Established baseline definition, and demonstrated, in a laboratory setting, construction of software systems from components generated by heterogeneous languages.
 - (U) Demonstrated interoperability of Ada, C, C++, and CLOS.
 - (U) Developed semi-automated and automated methods for constructing document retrieval systems.
 - (U) Demonstrated improved techniques for gisting, topic spotting and speakers spotting of speech.
- (U) FY 1993 Planned Program:
- (U) Develop robust capability for automatic scene segmentation.
 - (U) Release beta version compiler for the image understanding architecture, scalable parallel computer optimized for machine vision applications.
 - (U) Incorporate stereo vision into complete working autonomous systems.
 - (U) Develop software architectural framework for wide-area object sharing among electrical, mechanical and software design tools.
 - (U) Demonstrate human-aided machine text translation.
 - (U) Develop formal software architecture representation languages. Represent software architectures from key DoD domains using architecture representation languages, and a common visual model.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-11

PE Title: Computing Systems and
Communications Technology

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Deploy configured data sets to R&D community to support research on image understanding, stereo vision, planning, hybrid control, and machine learning.
 - (U) Develop robust systems to aid real-time planning of autonomous systems.
 - (U) Develop and demonstrate agent-based architectures for sharing design knowledge, manufacturing process planning, and manufacturing control.
 - (U) Develop architecture for a heterogeneous database system which integrates, interfaces, creates and maintains a single database from multiple non-interoperable intelligence community databases.
 - (U) Develop a corresponding machine learning strategy to enable computers to learn specific user interaction characteristics.
 - (U) Develop knowledge-based decision aids to support the rapid construction of multiple battle plans.
 - (U) Develop improved message-handling algorithms.
 - (U) Develop databases, evaluation techniques and advanced algorithms for document-image processing.
 - (U) Develop and install text data extraction system for DEA investigative reports.
- (U) FY 1994 Planned Program:
- (U) Develop domain-specific software architecture reuse mechanisms, including attachment of components from reuse libraries and automatic code generators.
 - (U) Develop executable software prototypes utilizing prototyping and specification languages.
 - (U) Develop robust capability for acquiring cartographic models from aerial imagery.
 - (U) Develop integrated learning strategies for autonomous systems.
 - (U) Develop recognition and identification algorithms for identifying targets from a moving vehicle.
 - (U) Achieve robust speech recognition performance under adverse acoustic conditions.
 - (U) Demonstrate preliminary automatic machine translation of text.
 - (U) Develop human computer interaction systems capable of acquiring task specific models of user interaction.
 - (U) Develop and demonstrate information fusion and aggregation services to facilitate interoperability of heterogeneous databases.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-11

PE Title: Computing Systems and
Communications Technology

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Develop computer aided design tools which include constraint propagation, tolerance management, and simulation of assembly processes for electro-mechanical systems.
- (U) Demonstrate command and control functionality using high performance computing technology.
- (U) Develop enhanced knowledge-based decision support tools that integrate historical "lessons learned" information which is acquired and indexed from previously developed and executed plans.
- (U) Demonstrate qualitative improvements for the training and aiding of human planners and analysts through the use of enhanced decision support tools in a realistic crisis scenario.
- (U) Develop unified retrieval extraction system for intelligence analysis of text.

D. (U) WORK PERFORMED BY: Stanford University, Palo Alto, CA; University of Southern California, Information Sciences Institute, Marina del Ray, CA; Carnegie Mellon University, Pittsburgh, PA; Harvard University, Cambridge, MA; University of Massachusetts, Amherst, MA; Computational Logic, Inc., Austin, TX; University of California at Berkeley, CA; Teleos Corporation, Palo Alto, CA; ISX Corporation, Woodland Hills, CA; General Electric, Schenectady, NY; Martin Marietta, Denver, CO; IBM, Oswego, NY; GTE, Chantilly, VA; Honeywell, Minneapolis, MN; and Rice University, Houston, TX.

E. (U) RELATED ACTIVITIES: Builds upon the new high performance computing technologies being produced under project ST-19 in this program element.

F. (U) OTHER APPROPRIATIONS FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-19

PE Title: Computing Systems and
Communications Technology

Budget Activity: 1. Technology Base

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
ST-19	High Performance Computing 110,829	134,388	237,926	Continuing	Continuing
ST-10	(20,499)	(22,078)			

As part of the consolidation and realignment of program elements and projects within ARPA, a portion of the Strategic Computing Project (ST-10) funding was transferred to ST-19 in FY 1994 and outyears. In FY 1994 \$66,029 was transferred.

B. (U) BRIEF DESCRIPTION OF PROJECT: This project develops High Performance Computing and Communications (HPCC) technologies leading to trillion operations per second (teraops) computing systems and billion bits per second (gigabits) networking with associated software technologies by the mid-1990's, and ensures this accelerated rate of advance for future defense needs. These results will be used in other ARPA and Defense programs for experimental application to critical defense problems, including embedded high performance systems for distributed C3 systems.

(U) The HPCC program includes microsystems component technology and advanced packaging, systems software technology, algorithms and programming tools for scalable parallel distributed heterogeneous systems, switches and protocols for gigabits capacity networks, and early use of experimental systems. The scalable computing and networking technologies will also enable the development of a national information infrastructure. This project produces the key high performance computing technologies that are the foundation for all of the new Defense science and technology thrust areas and the Presidential Initiatives in High Performance Computing and Communications including an infrastructure to enable accelerated technology transition.

UNCLASSIFIED

UNCLASSIFIED

FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-19

PE Title: Computing Systems and
Communications Technology

Budget Activity: 1. Technology Base

Date: April 1993

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Developed scalable parallel high performance systems of the 100 gigaops class (Thinking Machines CM-5 and the Intel Paragon).
- (U) Developed prototype software libraries and compilers for scalable parallel computing systems.
- (U) Deployed a wide area file system to over 130 groups to support transparent access of data and files across the Internet while providing the kinds of security and integrity commonly associated with private data.
- (U) Demonstrated the Mach operating system in a heterogeneous system of high performance workstations and parallel computing systems. Extended Mach to include support of multicomputers of 1000 nodes, new operating system services, and demonstrations of initial trusted versions.
- (U) Demonstrated scalable mass storage systems using redundant arrays of inexpensive disks which provide the basis for new commercial products.
- (U) Established five testbeds for gigabit/second network research which include over 20 sites using several different switching technologies. The testbeds are operating in the 100 megabit performance range with some early gigabit per second networks.
- (U) Demonstrated a prototype semiconductor manufacturing capability using computational prototyping, and developed designs for embeddable high density computing modules using scalable components.

(U) FY 1993 Planned Program:

- (U) Distribute prototype high performance computing (HPC) software library for experimental use in a wide area file system.
- (U) Define architecture for nationwide gigabit network including integrated ground based and space based communication channels.
- (U) Demonstrate major modules for teraops high performance computing systems and a scalable operating system suitable for heterogeneous and distributed teraops computing. Demonstrations will

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-19

PE Title: Computing Systems and
Communications Technology

Budget Activity: 1. Technology Base
Date: April 1993

include the associated development environments and trusted operating system capabilities.

- (U) Demonstrate first embeddable version of HPC technologies using multichip modules.
- (U) Develop ground stations for gigabit geosynchronous satellites with NASA.

(U) FY 1994 Planned Program:

- (U) Integrate real-time functionality into portable operating system technology.
- (U) Demonstrate C3 systems technology with scalable high performance network technology enabling full multimedia real-time information exchange using early gigabit networks.
- (U) Develop initial prototype of C3 and weapons systems using embeddable high performance computing (HPC) technologies. Demonstrations will have 10 billion operations per second per cubic foot based on 100 billion operation per second systems technology.
- (U) Demonstrate software and hardware compatibility between scalable commercial HPC system and embeddable versions.
- (U) Demonstrate scalable libraries for high performance computers of fundamental algorithms to enable rapid development of application software and algorithms for efficient implementations applied to critical DoD problems such as critical fluid dynamics and image processing.
- (U) Develop and distribute HPC software, documentation, performance measurements, and prototype applications using a wide area file system.
- (U) Demonstrate small scale gigabits network among the gigabit testbeds using both land and space based communications channels.
- (U) Demonstrate prototype on prototype small scale teraops systems with scalable mass storage and gigabit network interfaces.
- (U) Develop trusted user services for scalable operating systems.
- (U) Develop foundations for peta operations per second and terabits systems.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-19

PE Title: Computing Systems and
Communications Technology

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Demonstrate methods for automatically generating optimally efficient parallel algorithms for important classes of signal processing applications.
- (U) Develop software tools for design of wavelet-based signal processors for communications and automatic target recognition applications.

D. (U) WORK PERFORMED BY: Massachusetts Institute of Technology, Cambridge, MA; Intel Corporation, Hillsboro, OR; Carnegie Mellon University, Pittsburgh, PA; Thinking Machines, Cambridge, MA; Maden Tech, Arlington, VA; University of California/Berkeley, Berkeley, CA; Cray Research, Chippewa Falls, WI; and University of Southern California/Information Sciences Institute, Los Angeles, CA.

E. (U) RELATED ACTIVITIES: Program Element (PE) #0603739E, Project MT-04, Electronic Module Technology.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Project Number: ST-22
PE Title: Computing Systems and Budget Activity: 1. Technology Base
Communications Technology Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
ST-22	Software Engineering Technology (52,317*)	(37,449*)	39,096	Continuing	Continuing

*As part of a consolidation and realignment of Program Elements and Projects, Project ST-21 (SEI) was transferred to this project. Prior year funds are shown for continuity purposes.

B. (U) BRIEF DESCRIPTION OF PROJECT: Software technology is a top item on the DoD Key Technologies list because of continually increasing demands for quality software in DoD software-intensive systems, and the need for an advanced state of software engineering practice in their production. This project funds the Software Engineering Institute (SEI) and Software Technology for Adaptable, Reliable Systems (STARS) program.

(U) The SEI is a Federally Funded Research and Development Center (FFRDC) established in 1984 to conduct programs in software engineering. The SEI is composed of world class software engineers whose efforts are directed at transitioning technology and the acceptance of modern software engineering techniques and methods, promulgating their use throughout the defense industry, and establishing standards of excellence for the software engineering profession.

(U) The STARS program is developing a family of large-scale "software factory" products through large aerospace companies that have strong technology transition paths to their commercial counterparts. STARS will demonstrate a process-driven, domain-specific, reuse-based approach to software engineering. STARS is generating three key integrating elements: a set of Software Engineering Environments (SEEs); a set of modern tailorable software life-cycle process building blocks; and a software asset library capability to facilitate software productivity. The SEEs will be composed of commercially-supported products with open interfaces to stimulate the Computer Aided Software Engineering (CASE) tools marketplace. The SEEs will reinforce use of modern process models, have seamless interfaces to asset libraries, and will be evaluated on current DoD programs. SEI and STARS efforts are aimed at enabling future DoD software

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-22

PE Title: Computing Systems and
Communications Technology

Budget Activity: 1. Technology Base
Date: April 1993

intensive weapon systems to meet mission requirements quickly and affordably.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Prepared initial version of Software Capability Evaluation (SCE) handbook.
- (U) Initiated the identification of a core set of software engineering measures.
- (U) Refined the Capability Maturity Model.
- (U) Prepared and tested alpha version of a Real Time Simulation handbook..
- (U) Developed initial state of the practice report on risk management.
- (U) Initiated STARS process asset library.
- (U) Selected STARS Software Engineering Environments (SEE) demonstration projects.
- (U) Began integration of process mechanisms and reuse asset library mechanisms into the three STARS SEEs.
- (U) Evaluated and extended STARS software asset library capabilities.

(U) FY 1993 Planned Program:

- (U) Develop risk management mechanisms and courses.
- (U) Provide a revised questionnaire for the Capability Maturity Model.
- (U) Initiate research and education on secure systems engineering.
- (U) Develop engineering analysis techniques for software architectural design decisions and conduct case studies.
- (U) Prepare a rate monotonic analysis handbook with examples of common real-time system patterns.
- (U) Complete STARS SEE initial operational capability.
- (U) Continue development of STARS process asset library.
- (U) Tailor STARS SEEs, asset libraries, and process building blocks for use on Service demonstrations.
- (U) Evaluate and extend STARS software asset library capabilities and plan for its transition to become self-supporting.
- (U) Develop prototype STARS software development plan 2000.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-22

PE Title: Computing Systems and
Communications Technology

Budget Activity: 1. Technology Base
Date: April 1993

(U) FY 1994 Planned Program:

- (U) Prototype an integrated process improvement framework.
- (U) Develop unified, adaptable models for re-engineering and reuse.
- (U) Initiate engineering techniques maturity model and practices.
- (U) Develop and prototype risk management processes.
- (U) Develop and prototype structural models for dependable distributed systems.

D. (U) WORK PERFORMED BY: The SEI is a Federally Funded Research and Development Center. The contractor is Carnegie Mellon University, Pittsburgh, PA. The STARS prime contractors are Boeing Aerospace Corporation, Kent, WA; IBM Federal Systems Company, Gaithersburg, MD; and Paramax, McLean, VA.

E. (U) RELATED ACTIVITIES:

- (U) 0602301E, Intelligent Systems and Software (ST-11)
- (U) 0601101E, Information Sciences (CCS-02)
- (U) 0603756D, Consolidated DoD Software Initiative (Ada Program)
- (U) 0604740F, Computer Resource Management Technology.

(U) The ARPA PE activities above are managed to ensure that there is no duplication of effort among programs. ARPA ensures that SEI and STARS commonalities are synergetic by supporting a joint STARS/SEI team to work on process element definitions.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Project Number: ST-23
PE Title: Computing Systems and Budget Activity: 1. Technology Base
Communications Technology Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
ST-23 Surveillance Research	(19,466*)	26,351	21,486	Continuing	Continuing

*This project was funded under program element #0602714E, project NM-01 in FY 1992 and prior.

B. (U) BRIEF DESCRIPTION OF PROJECT: This multifaceted research program is conducted to enhance U.S. surveillance capabilities for monitoring worldwide nuclear explosions and to develop methods for detecting the production, testing and storage of nuclear materials and weapons. Additionally, this program provides the required technical support for U.S. participation in the Conference on Disarmament for the development and testing of an International Monitoring System, and for nuclear test treaty negotiations. The advanced surveillance technologies developed in this program are adapted into existing operational nuclear monitoring systems. This program also addresses methods for demonstrating technologies to enhance the monitoring of the Nuclear Non-Proliferation Treaty and its renewal. This research supports the Global Surveillance and Communications (GSC) DDR&E thrust area.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Demonstrated prototype Intelligent Monitoring System incorporating data from a network of high frequency arrays and high performance stations.
- (U) Completed and transferred technologies to utilize data collected during on-site inspections.
- (U) Provided technical support to nuclear testing negotiations, including the Conference on Disarmament.

(U) FY 1993 Planned Program:

- (U) Begin transfer of the technology of advanced seismic arrays and Intelligent Monitoring System components to the U.S. Atomic Energy Detection System.
- (U) Complete transfer of technology from the advanced yield estimation program into operational monitoring system.
- (U) Begin planning for demonstration of a Comprehensive Test Ban Treaty (CTBT) monitoring system.

UNCLASSIFIED

UNCLASSIFIED

FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-23

PE Title: Computing Systems and
Communications Technology

Budget Activity: 1. Technology Base
Date: April 1993

- (U) Provide technical support to international negotiations on nuclear testing including technical support to the Conference on Disarmament.
- (U) Prototype smart surveillance systems for collection of monitoring data on a global scale.
- (U) Begin program to develop high resolution, room temperature radiation sensors for monitoring and inspection purposes.
- (U) Begin development of laboratory nanoscale particle assay techniques.
- (U) Begin development of components of a global nuclear proliferation monitoring system.

(U) FY 1994 Planned Program:

- (U) Develop and test advanced technologies for automatic sampling and analysis of nuclear materials for global nuclear proliferation monitoring.
- (U) Develop technologies for nuclear threshold monitoring on a global basis.
- (U) Begin program in machine learning and neural net decision-making for improved seismic data analysis and event identification.
- (U) Provide technical support to international negotiations on nuclear testing including technical support to the Conference on Disarmament. Conduct large-scale preliminary tests to demonstrate the capabilities of the international monitoring system.
- (U) Complete technologies for automated signal analyses and transfer to operational systems.
- (U) Prototype high-resolution room temperature radiation sensors into lightweight systems for proliferation monitoring.
- (U) Develop laboratory nanoscale particle analysis techniques for improved interpretation of nuclear samples.
- (U) Demonstrate components for a global nuclear non-proliferation monitoring system and install prototypes in key locations in the Mid-east and Asia near areas of nuclear concern.

D. (U) WORK PERFORMED BY: Major performers include: Teledyne Geotech, Garland, TX; Science Applications International Corporation, San Diego, CA; University of Florida, Gainesville, FL; Southern Methodist University, Dallas, TX; California Institute of Technology, Pasadena, CA; Columbia University, New York, NY; Constellation Technologies, Inc., Gainesville, FL; Hughes Santa Barbara Research Center, Santa Barbara,

UNCLASSIFIED

UNCLASSIFIED

FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Project Number: ST-23
PE Title: Computing Systems and Budget Activity: 1. Technology Base
Communications Technology Date: April 1993

CA; Grumman Aerospace Corp., Bethpage, NY; and Mission Support Inc., Salt Lake City, UT.

E. (U) RELATED ACTIVITIES: Complementary research is conducted by the National Labs of the Department of Energy and by the Air Force Technical Applications Center for operational applications. Close coordination of the program is carried out with the CIA Nuclear Non-proliferation Center.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Agreements with Norway, the Federal Republic of Germany and China call for joint activities in seismic facilities in those countries. The United Nations' Conference on Disarmament, with U.S. concurrence, has formally agreed on the development of the international monitoring system and large scale tests of this system, and agreements have been made with a large number of countries, including Russia, China, Egypt, and Pakistan to support this effort.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Budget Activity: 1. Technology Base

PE Title: Tactical Technology

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1992 Actual</u>	<u>FY 1993 Estimate</u>	<u>FY 1994 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
TT-03 Naval Warfare Technology	58,091	33,154	33,828	Continuing	Continuing
TT-04 Close Combat Technology	25,309	4,285	28,300	Continuing	Continuing
TT-05 Advanced Targeting Technology	19,733	15,963	48,098	Continuing	Continuing
TT-06 Advanced Tactical Technology	15,859	19,367	26,285	Continuing	Continuing
TT-07 Aeronautics Technology	9,060	25,250	7,380	Continuing	Continuing
TOTAL	128,052	98,019	143,891		

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element is dedicated to the advancement of concepts and technologies directed toward next generation tactical systems. Major objectives are: (1) enabling technologies for Command, Control and Intelligence for littoral warfare, automating an integrated ship design process and automating platform systems; (2) lighter, more deployable forces in close combat technology and increase efforts for ground combat; (3) tactical weapons sensors and processors with emphasis on direct connectivity between sensors and weapon delivery systems; (4) lasers and microwaves to improve the performance of critical electronic warfare, radars, electronic displays, sensors, and communications systems; and (5) produce effective and affordable conventional aerospace technology systems with significantly enhanced capabilities.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-03
Budget Activity: 1. Technology Base
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1992 Actual</u>	<u>FY 1993 Estimate</u>	<u>FY 1994 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
TT-03 Naval Warfare Technology	58,091	33,154	33,828	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: The Naval Warfare Technology project is developing new technologies for application to a broad range of naval requirements. The project is developing enabling technologies for Command, Control, Communications, and Intelligence (C3I) for Littoral Warfare, automating an integrated ship design process and automating weapon and platform systems employed in littoral warfare. The products will help decision makers better employ the resources under their control and enhance the affordability of future ship systems through automation and more effective ship design processes.

(U) The C3I/Synthetic Environments effort will develop integrated employment and execution aids for demonstration in the Commander in Chief (CINC) Command Complex to assist in carrying out strike, mine warfare, amphibious assault, and other near-land warfare missions. Advanced simulation technologies are being developed to support training, operations, and systems acquisition.

(U) The Ship Systems Automation (SSA) effort will demonstrate advanced, highly automated combat and platform systems for submarine and surface ship applications. Technology developments include intelligent command-level decision support components; automated sensor systems that fuse multi-source data and dynamically reconfigure based on the current tactical situation; and automated fire control systems that intelligently determine optimal attack and defense solutions. These will be capable of adapting to modified tactics and countermeasures, as well as intelligent signature, damage, maneuvering, and machinery/equipment controls.

(U) Simulation Based Design (SBD) is developing integrated automated tools to enable fundamental changes in the process for ship design to facilitate combining affordability with requisite performance characteristics in future naval and commercial vessels. Virtual prototyping will provide simulations for concurrent assessments of design performance, producibility, quality, and cost. This process will systematically and comprehensively assess the impact of technology

UNCLASSIFIED

UNCLASSIFIED

FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-03
Budget Activity: 1. Technology Base
Date: April 1993

insertion on ship mission performance and overall life cycle affordability from early in the design cycle.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Demonstrated advanced bi-static processing technology at sea.
- (U) Demonstrated passive-acoustic sonar scene description system at sea.
- (U) Demonstrated full-beam automated processing at a U.S. Navy ocean surveillance facility.
- (U) Demonstrated an Acoustic Warfare Battle Management Decision Support System for Fleet Commander.

(U) FY 1993 Planned Program:

- (U) Demonstrate optimization of resource allocation with the Acoustic Warfare Battle Management Decision Support System for Fleet Commander.
- (U) Demonstrate Anti-Submarine Warfare (ASW) passive acoustic multi-sensor fusion using real-time data.
- (U) Prepare concept design for Ship Systems Automation (SSA) program.
- (U) Design Simulation-Based Design (SBD) system architectures and operating system modules.

(U) FY 1994 Planned Program:

- (U) Demonstrate full fidelity acoustic synthetic ocean environment simulation capability.
- (U) Initiate development of employment, deployment and execution aids for Commander in Chief (CINC) Command Complex.
- (U) Develop system architecture and initiate detailed design for SSA.
- (U) Conduct laboratory demonstration of SSA concept.
- (U) Demonstrate initial SBD virtual prototyping using three-dimensional ship design database.

D. (U) WORK PERFORMED BY: AT&T Bell Laboratories, Whippany, NJ; Orincon Corporation, San Diego, CA; Science Applications International Corporation, McLean, VA; Johns Hopkins University, Laurel, MD; Naval Command and Control and Oceans Systems Center, San Diego, CA; Naval Undersea Warfare Center, Newport, RI; Alliant TechSystems, Arlington, VA; Lockheed Missiles & Space, Palo Alto, CA; and General Dynamics, Electric Boat Division, Groton, CT.

UNCLASSIFIED

UNCLASSIFIED

FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-03

PE Title: Tactical Technology

Budget Activity: 1. Technology Base

Date: April 1993

E. (U) RELATED ACTIVITIES: To ensure there is no duplication of effort, this program is coordinated with the Office of Naval Research, Space and Naval Warfare Systems Command, and Naval Sea Systems Command. Related efforts are as follows:

- (U) PE 0602314N Undersea Surveillance & Weapons Technology
- (U) PE 0602232N Command, Control, Communications, and Intelligence (C3I) Technology
- (U) PE 0603555N Enhanced Advanced Technology Demonstration (ATD) (shallow water technology)
- (U) PE 0603747N Advanced Anti-Submarine Warfare (ASW) Technology.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

UNCLASSIFIED

UNCLASSIFIED

FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-04
Budget Activity: 1. Technology Base
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1992 Actual</u>	<u>FY 1993 Estimate</u>	<u>FY 1994 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
TT-04 Close Combat Technology	25,309	4,285	28,300*	Continuing	Continuing

*Includes efforts initiated in prior years in PE 0603737D, Balanced Technology Initiative.

B. (U) BRIEF DESCRIPTION OF PROJECT: This project supports four main efforts: the light contingency vehicle; integrated survivability; technologies for contingency operations with initial focus on the dismounted soldier; and thermophotovoltaic electric generation for underwater and cogeneration applications.

(U) The Light Contingency Vehicle (LCV) program is developing concepts and technologies to improve the deployability and capability of light forces. Rapid response missions require air liftable and, in some cases, air droppable vehicles capable of facing heavy armored forces. Current vehicles used for this purpose, such as the HMMWV, have limited rates of fire and almost no protection. The LCV vehicle will be a small, lightweight (under 12 tons), highly mobile armored vehicle with a variety of applications. Survivability will be achieved through a flexible combination of advanced attachable armor and unconventional survivability techniques. Firepower will be achieved principally through a communications link to a separate firing platform such as the non line-of-sight (NLOS) missile. Modern battle management techniques will also be integrated including land navigation, position display on electronic maps, and automated identification of friend or foe (IFF).

(U) The Integrated Survivability program is developing technologies to address various aspects of survivability, including kill avoidance (with advanced armors), hit avoidance (with countermeasures and active defense), and detection avoidance. These technologies will be developed and tested separately, then integrated onto a testbed such as the LCV.

(U) The Contingency Technologies program is focusing on improving the lethality, survivability, and situation awareness of the dismounted soldier. The initial effort is to apply developing commercial personal communications technologies to the command/control and situation awareness of the dismounted soldier. Two-way voice/data communications will be provided to each soldier in a squad, and their position will be displayed to the squad leader, who will also receive this information

UNCLASSIFIED

UNCLASSIFIED

FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-04
Budget Activity: 1. Technology Base
Date: April 1993

from adjacent squads. This will serve as a testbed system for the Army to determine the utility and requirements of the system.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Tested five major near-term combat Identification Friend and Foe technologies.
- (U) Completed Optical Access combustion chamber for Turbo-Roto-Compound (TRC) engine.
- (U) Completed field tests of brassboard vehicle-mounted and hand-held mine detection systems; continued development of airborne mine detection technology and anti-helicopter mine.

(U) FY 1993 Planned Program:

- (U) TRC engine: begin three-cylinder technology demonstration.
- (U) Test anti-helicopter mine form/fit systems.
- (U) Perform concept refinement for Land Warrior use of commercial communication devices.
- (U) Initiate studies and technologies for contingency vehicle Battlefield Management systems.
- (U) Develop and demonstrate efficient thermophotovoltaic electric generation for underwater and cogeneration applications.

(U) FY 1994 Planned Program:

- (U) Finalize concept definition of light contingency vehicle (LCV) and begin design.
- (U) Complete initial design of TRC 3 cylinder engine and begin fabrication of engine and air handling systems.
- (U) Begin development of technologies for contingency operations with initial focus on the application of commercial communications systems to support the dismounted soldier.
- (U) Continue exploratory studies, simulations for contingency vehicle battlefield management systems.
- (U) Develop and demonstrate technology for the Small, Low Cost Intercept Device (SLID) program and integration of armor to protect high value assets at standoff.
- (U) Begin demonstration of netted, controllable and helicopter minefields.
- (U) Develop and demonstrate the simulation-based design workstations required to simultaneously address performance and producibility of new weapons concepts.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-04
Budget Activity: 1. Technology Base
Date: April 1993

D. (U) WORK PERFORMED BY: The major performers include Hughes Aircraft, El Segundo, CA; Raytheon, Lexington, MA; Detroit Diesel Corporation, Detroit, MI; Textron Defense, Wilmington, MA; Lawrence Livermore Laboratories, Livermore, CA; University of Iowa, Iowa City, IA; Texas Instruments, Dallas, TX; TRW, Redondo Beach, CA; Allied Signal, Towson, MD; and Rockwell International, Duluth, GA.

E. (U) RELATED ACTIVITIES: LCV development is being supported by the Army in PE 0603005A, Combat Vehicle and Automotive Advanced Technology, and by the USMC in PE 0602131M, Marine Corps Landing Force Technology, as part of a coordinated joint effort.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-05

PE Title: Tactical Technology

Budget Activity: 1. Technology Base

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
TT-05	Advanced Targeting Technology (WAR BREAKER)				
	19,733	15,963	48,098*	Continuing	Continuing
BTI	(12,000)	(36,500)			

*Includes \$23 million for effort initiated in prior years in PE0603737D, Balanced Technology Initiative.

B. (U) BRIEF DESCRIPTION OF PROJECT: Recent experience in Desert Storm has dramatically demonstrated our current inability to prosecute tactical ballistic missile (TBM) launchers. The WAR BREAKER program will develop and demonstrate advanced technology and systems to enable the detection, identification and prosecution of a wide range of high value, time critical fixed and mobile targets including TBM launchers, mobile command posts, tanks and artillery. This project develops advanced sensor and processing technologies including advanced automatic target recognition, sensor fusion, stochastic target detection strategies data fusion, image understanding, text understanding and sensor technologies. Emphasis is on enabling technologies that support effective search and strike against existing and future targets, in deep hide and/or employing advanced deception/concealment techniques. Included in the enabling technology is the Damocles Autonomous Submunition, an effort that was transitioned from the Balanced Technology Initiative (BTI) to ARPA.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Demonstrated infrared microdetector with linear array.
- (U) Completed Acoustic Charge Transport (ACT) development.
- (U) Evaluated advanced signal processing concepts for radar and electro-optical/infrared electro-optic infrared (EO/IR) sensors focusing on improvements to wide area coverage, deep hide target detection and automatic target recognition.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-05

PE Title: Tactical Technology

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Expanded tactical ballistic missile target tracking capability to include time critical target and geographic regions.
 - (U) Evaluated Intelligence Correlation and Planning monitoring system and developed preliminary designs for advanced automated operational planning.
 - (U) Initiated evaluation of sophisticated unattended ground sensors; developed requirements for intelligent algorithms and communications for internettted sensors.
 - (U) Developed command/control concept to support rapid sensor-to-shooter target insertion.
- (U) FY 1993 Planned Program:
- (U) Demonstrate feasibility of command/control connectivity to support rapid sensor to shooter target data flow.
 - (U) Evaluate advanced radar and EO/IR system concepts for focused surveillance applications.
 - (U) Acquire test data to assess target detectability in foliage using an ultra wideband High Frequency (HF)/Ultra High Frequency (UHF) synthetic aperture radar (SAR) system.
 - (U) Continue unattended ground sensor algorithm communications development.
- (U) FY 1994 Planned Program:
- (U) Continue Damocles proof of principle technology development and begin experiment.
 - (U) Analyze and assess the performance of algorithms in detecting man-made targets in foliage from imaging radar and ultra-wideband (UWB) SAR data.
 - (U) Acquire and analyze data to assess potential discriminants for detecting and identifying targets in deep clutter based on active laser phenomenology.
 - (U) Initiate Unattended Ground Sensor (UGS) brass board development.
 - (U) Commence Imagery Exploitation System (IES) Cycle 3 development to incorporate a new imagery sensor type, reduce processing speed and focus on specific theaters.
 - (U) Conduct exclusive field evaluation of CAPABAS and the SRI Ultra Wide-Band Synthetic Aperature Radar.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-05

PE Title: Tactical Technology

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Continue automatic target detection/recognition (ATD/R) technology development supporting prosecution of deep hide targets.

D. (U) WORK PERFORMED BY: General Dynamics/Convair Division, San Diego, CA; Martin-Marietta, Orlando, FL; ERIM, Ann Arbor, MI; Lincoln Laboratory, Lexington, MA; Texas Instruments, Dallas, TX; BDM International, McLean, VA; SAIC International, Arlington, VA; Boeing Corporation, Seattle, WA; and others to be determined.

E. (U) RELATED ACTIVITIES:

- (U) PE #0603226E, Project EE-40, Critical Mobile Targets, is directly dependent on technologies developed in this project.
- (U) This project is a part of the ARPA contribution to the Joint DoD Advanced Technology Demonstration for Global Surveillance and Communication and Precision Strike thrust areas. The specific projects have been coordinated with Army, Navy, and Air Force.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-06
Budget Activity: 1. Technology Base
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
TT-06 Advanced Tactical Technology	15,859	19,367	26,285	Continuing	Continuing

*Increase in FY 1994 due to merger of ST-12 into TT-06.

B. (U) BRIEF DESCRIPTION OF PROJECT: This project is focused on the technology and applications of lasers, microwave generators and mathematical algorithms for signal processing to improve the performance of critical electronic warfare, radars, electronic displays, sensors and communications systems. Five broad technology areas are being investigated: (a) compact, efficient, frequency-agile, diode-pumped, solid-state lasers for laser radars and sensors; (b) narrowband and wideband microwave source development for radars and decoys; (c) vacuum micro-electronics for smaller and better microwave tubes; (d) novel signal processing methods for radar data processing and target recognition; and (e) fast computational methods for electromagnetic scattering and acoustic propagation in turbulent flows.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Demonstrated laboratory breadboard operation of continuous wave diode-pumped solid state laser operating at two microns with 15 watt output power.
- (U) Initiated a program to develop linear and two-dimensional arrays of microlasers for laser radars.
- (U) Completed 94 gigahertz (GHz) power amplifier gun design.
- (U) Demonstrated uniform current emission and long-life operation of microcathode.
- (U) Completed coherent integration of time-array signal processor for impulse radar.
- (U) Completed cooperative Angle Jamming study and simulation against monopulse radars.
- (U) Completed simulations of on-board, off-board electronic countermeasure technique against monopulse missile seekers.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-06
Budget Activity: 1. Technology Base
Date: April 1993

- (U) Completed simulation study on the utility of laser countermeasures and sensor protection concepts in air defense scenarios.
- (U) FY 1993 Planned Program:
- (U) Demonstrate field transportable brassboard/lasers operating at high average power in the visible and mid-infrared spectral regions.
 - (U) Initiate a program for adaptive pointing and tracking of targets for countermeasures applications.
 - (U) Demonstrate high power operation of 94 gigahertz GHz amplifier.
 - (U) Demonstrate microcathode operation at 1 GHz modulation and 5 ampere per square centimeter emission.
 - (U) Design and fabricate on-board, off-board electronic countermeasure signal processor and generator.
 - (U) Begin design of an electronic system to demonstrate cooperative angle jamming technique.
 - (U) Begin design of a 2 Watt, 44 GHz quasi optical millimeter wave power amplifier.
- (U) FY 1994 Planned Program:
- (U) Design, fabricate, assemble and field test an ultra-wide-band radar prototype.
 - (U) Initiate a holographic data storage program to achieve one billion bit per second data transfer rate and a storage capacity of 100 billion bits.
 - (U) Design and fabricate electronic system to demonstrate cooperative angle jamming technique.
 - (U) Demonstrate 10 GHz operation of microcathode to miniaturize microwave power tubes.
 - (U) Design and fabricate 44 GHz and 94 GHz, high power, high efficiency amplifiers.
 - (U) Demonstrate kilowatt average power lasers for laser radar applications.
 - (U) Develop designs and critical technology components for a 30 watt average power tunable, mid infrared laser for countermeasures and laser radar applications.
 - (U) Develop wavelet-based design tools for rapid design of novel digital signal processing algorithms and hardware for communication and target recognition.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-06
Budget Activity: 1. Technology Base
Date: April 1993

- (U) Transition wavelet methods, developed for detection of transient signals in sonar systems, to development of multisensor fusion systems.
- (U) Fabricate and test a 2 Watt, 44 GHz quasi optical millimeter wave power amplifier.
- (U) Demonstrate new computational procedures for signal processing in airborne platforms; enables communications with low cost antenna arrays for application to low probability of intercept communications and frequency reuse for military communications.
- (U) Develop a new class of procedures for simplifying output of expensive simulations and experiments for design, optimization, and control.

D. (U) WORK PERFORMED BY: Major performers include: Hughes Aircraft Company, El Segundo, CA; Science Research Laboratory, Somerville, MA; TRW, Redondo Beach, CA; Lockheed/Sanders, Nashua, NH; Varian Associates, Palo Alto, CA; Honeywell, Bloomington, MN; and Northrop Corporation, Hawthorn, CA.

E. (U) RELATED ACTIVITIES: All programs are coordinated with Services' R&D programs to promote technology transfer and avoid duplication of effort.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Advanced Research Projects Agency (ARPA) is also an active participant in the US-UK Information Exchange Program on laser technology and effects.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-07
Budget Activity: 1. Technology Base
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
TT-07	Aeronautics Technology				
	9,060	25,250	7,380*	Continuing	Continuing
BTI	(7,300)	(9,500)			

*Includes \$4.6 million for a program previously funded in PE 0603737D, Balanced Technology Initiative.

B. (U) BRIEF DESCRIPTION OF PROJECT: As the Department of Defense (DoD) attention focuses on enhancing conventional defenses, the requirement to produce effective, survivable and affordable weapon systems becomes increasingly more important. The timely development of cost-effective enabling technologies for aircraft and missiles is the objective of the Aeronautics Technology Project. Three focused efforts are planned in FY 1994. The micro-balloon radar absorbing material (RAM) effort is examining the application of hollow ceramic spheres for lightweight RAM. A second effort is investigating advanced infrared treatment concepts. The third effort is focused on improved communications (Speakeasy). Its' objective is to develop an affordable, multimode radio. The results of this project will be disseminated to DoD systems programs to enable future development of affordable, conventional weapon systems that will greatly enhance our ability to perform both 'battle management' and 'battle execution' functions. This effort is part of the Air Superiority and Defense DDR&E thrust area. In FY 1993 this project includes the congressionally directed DP-2 Vectored Thrust Technology Demonstration program.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Completed designs for miniature turbine engine.
- (U) Completed fuel cell study for advanced Aircraft.
- (U) Completed F-15 Test of mid-wave Infrared (MWIR) coating.
- (U) Initiated study of advanced materials for low cost expendable engines.

(U) FY 1993 Planned Program:

- (U) Assemble, bench check and performance test miniature turbine engines.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-07

PE Title: Tactical Technology

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Continue investigation of advanced treatment concepts for IR suppression.
- (U) Study post launch destruct mechanisms.
- (U) Investigate applications of Advanced Landing Systems (ALS) technology.

(U) FY 1994 Planned Program:

- (U) Investigate IR treatments compatible with radar and visual signature materials.
- (U) Investigate advanced low cost expendable engine application.
- (U) Initiate Phase II of Speakeasy development.

D. (U) WORK PERFORMED BY: Institute for Defense Analyses, Alexandria, VA; Sundstrand Power Systems, San Diego, CA; Lockheed, Burbank, CA; General Dynamics, Fort Worth, TX; Spectro Dynamic Systems, Hickory, NC; Hazeltine Corporation, Greenlawn, NY; TRW, San Diego, CA; Naval Air Warfare Center, Warminster, PA; NASA, Ames Research Center, Sunnyvale, CA; Naval Research Laboratory, Washington, DC; and Rome Laboratory, Griffiss AFB, NY.

E. (U) RELATED ACTIVITIES: In FY 1995, Speakeasy will transition to Air Force (PE #0603789F) and Army (PE #0602782A).

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E
 PE Title: Integrated Command and
Control Technology

Budget Activity: 1. Technology Base
 Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
IC-01* Distributed Information Systems	16,408	0	0	0	Transferred to PE 0602301E
IC-02* Advanced Command, Control & Communications Technology	17,600	0	0	0	Transferred to PE 0602301E
IC-03 High Definition Systems (HDS)	75,000	152,180	57,214	Continuing	Continuing
TOTAL	<u>109,008</u>	<u>152,180</u>	<u>57,214</u>		

*These projects reflect the Program Element/Project consolidation and realignment within ARPA.

B. (U) BRIEF DESCRIPTION OF ELEMENT: This Program Element developed and demonstrated technology under Distributed Information Systems for building systems that can fulfill DoD needs for information processing of DoD Command, Control and Communication Technology applications. In Advanced Command, Control and Communication Technology, development was aimed at secure, survivable, intelligent networks, utilizing advanced architectures and devices for controlling large-scale, high performance secure communication networks for world wide command and control. The High Definition Systems (HDS) Project is dedicated to the development of technology and manufacturing capability for high definition displays to be used in military systems. This effort will establish a domestic technical capability and demonstrate manufacturing capability of the components necessary for military systems that capture, process, store, distribute and display high resolution images. The programs contained in Project IC-03, High Definition System (HDS) reflect the Department's initiative to support dual-use technologies.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E Project Number: IC-03
PE Title: Integrated Command and Budget Activity: 1. Technology Base
Control Technology Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
IC-03	High Definition Systems (HDS) 75,000	152,180	57,214	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: This program is an effort to develop the technology and manufacturing capability for high definition displays and is important for virtually all DoD applications which involve visual and graphic information. Major components of this program include: projection, head mounted and direct view displays based on multiple technologies; display architectures and processors; compression algorithms; and high speed data transmission. These efforts will establish a domestic technical capability and demonstrate manufacturing capability of the components necessary for military systems that capture, process, store, distribute and display high resolution images.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Built 20-inch flat tension mask Cathode Ray Tube using interchangeable mask process.
- (U) Demonstrated full color electroluminescent display.
- (U) Completed, design of 2 megapixel deformable mirror device, associated projection optics, and drive electronics.
- (U) Demonstrated prototype rapid thermal annealing system.
- (U) Developed large area extrusion coater.
- (U) Developed precision large area LCD assembly system.
- (U) Identified materials and processes for LCD color filters.
- (U) Demonstrated 3-D volumetric display.
- (U) Completed plasma display 256 level gray scale driver IC design.
- (U) Demonstrated 19" 640x480 color plasma display with 64 gray levels.
- (U) Demonstrated fabrication of color EL devices by ion implantation.
- (U) Developed higher brightness electroluminescent displays

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E

Project Number: IC-03

PE Title: Integrated Command and
Control Technology

Budget Activity: 1. Technology Base

Date: April 1993

- using low resistance address lines.
- (U) Completed high resolution video workstation design and software.
- (U) Completed second generation high performance scalable image computer design.
- (U) Demonstrated sub-band and fractal image compression technique.
- (U) Demonstrated 1 Gb/s LAN-based workstation architecture.

(U) FY 1993 Planned Program:

- (U) Initiate active matrix liquid crystal display (AM-LCD) Pilot Demonstration Facility.
- (U) Initiate National Center for Advanced Information Components Manufacturing (NCAICM).
- (U) Deliver 2.3 million pixel 3-light valve digital micromirror projection display.
- (U) Demonstrate large area 51 inch diagonal tiled liquid crystal display.
- (U) Demonstrate high resolution 22" flat tension mask CRT.
- (U) Demonstrate stereo camera and stereo hard copy printer.
- (U) Develop offset printing equipment and process for color filter fabrication.
- (U) Develop new low voltage phosphors for field emission displays.
- (U) Establish cost projections for color TFEL pilot line.
- (U) Demonstrate 3" monochrome flat CRT.
- (U) Demonstrate proof-of-concept 3-D autostereoscopic display.
- (U) Design large area high performance microlithography tool.
- (U) Fabricate thin film transistors and displays using rapid thermal system.
- (U) Develop large area plasma deposition processes for liquid crystal display manufacturing.
- (U) Demonstrate 19" 640x480 color plasma display with 256 gray levels.
- (U) Demonstrate feasibility of 72 color pixels/inch plasma display.
- (U) Demonstrate 10" full color electroluminescent display.

(U) FY 1994 Planned Program:

- (U) Continue Phase II of Active Matrix Liquid Crystal Display Pilot Demonstration Facility.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E

Project Number: IC-03

PE Title: Integrated Command and
Control Technology

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Demonstrate 10" monochrome flat CRT.
- (U) Demonstrate 20" 1280x1024, 256 gray level color flat panel workstation display.
- (U) Deliver 1280x1024 8-bit driver for active matrix liquid crystal displays.
- (U) Demonstrate 10" color 1280x1024 active matrix liquid crystal display.
- (U) Demonstrate dyed polymer dispersed liquid crystal displays.
- (U) Demonstrate active matrix liquid crystal display using offset printed color filters.
- (U) Demonstrate 0.1% efficient blue light emitting diode.
- (U) Improve electroluminescent lamps for liquid crystal display backlights developed.
- (U) Demonstrate small area color field emission display.
- (U) Demonstrate gated diamond field emitter device structures.
- (U) Complete production of rapid thermal anneal system for poly-Si thin film transistors fabrication.
- (U) Complete liquid crystal display ion implanter system.
- (U) Demonstrate prototype multiprocessor scalable image computing environment.
- (U) Complete liquid crystal display laser annealing system.

D. (U) WORK PERFORMED BY: The major performers are: Xerox Corporation, Palo Alto, CA; Magnascreen Corporation, Pittsburgh, PA; Photon Dynamics, Inc., San Jose, CA; XMR, Inc., Santa Clara, CA; Texas Instruments, Dallas, TX; MRS Technology, Inc., Chelmsford, MA; Planar Systems, Beaverton, OR; Sarnoff Research Center, NJ; and Zenith Corporation, Chicago, IL; and Sandia National Lab, Albuquerque, NM.

E. (U) RELATED ACTIVITIES: This project is coordinated with the advanced display technology being developed by the Army Electronics Devices and Technology Laboratory and the Air Force Aircraft Cockpit Integration Directorate and Manufacturing Technology (MANTECH) Directorate at Wright Laboratory. There is no unnecessary duplication within DoD.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Budget Activity: 1. Technology Base

PE Title: Materials and Electronics
Technology

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
MPT-01	Materials Processing 85,264	73,529	81,328	Continuing	Continuing
MPT-02	Electronics Processing 22,511	37,952	79,386	Continuing	Continuing
MPT-03	Optoelectronics/GaAs 14,634	36,877	0	0	74,237
MPT-04	Advanced Lithography 76,000	71,293	0	0	236,820
MPT-06	High Temperature Superconductivity (HTSC) 0	35,461	37,788	Continuing	Continuing
TOTAL	198,409	255,112	198,502		

B. (U) BRIEF DESCRIPTION OF ELEMENT: The objective of this program element is to develop technology related to those materials and devices that make possible a wide range of new military and commercial capabilities. The programs contained in this Program Element reflect the Department's initiative to support dual-use technologies.

(U) The Materials Processing project (MPT-01) concentrates largely on the application of process modeling, sensors, and advanced control of materials manufacturing and flexible fabrication and assembly. It encompasses biosensor and chemical surveillance, metal matrix composite research, synthesis of diamond films for thermal management, and research in freeform manufacturing capabilities for high performance structural materials to fabricate functional components directly from Computer Aided Design (CAD) systems.

(U) The Electronics Processing project (MPT-02) develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies for infrared devices. It creates the technology base for advanced electronic and optoelectronic components to meet next-generation requirements. HTSC materials covered in project MPT-06 have reached a stage of development when specific applications can be identified in thin-film electronic devices and circuitry for military avionics with concurrent benefit to commercial electronics. ARPA is concentrating on radar and electronic detection systems and the continued fabrication of thin films.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-01

PE Title: Materials and Electronics
Technology

Budget Activity: 1. Technology Base
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
MPT-01 <u>Materials Processing Technology</u>	85,264	73,529	81,328	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: The major goals of this project are to develop novel materials, processing techniques, and fabrication strategies for production of advanced structural composites with improved performance and at lower manufacturing costs. A major area of concentration is the application of process modeling, sensors, and advanced control to materials manufacturing and flexible fabrication and assembly. Other predominant areas include: biosensors for chemical surveillance, research into metal matrix composites for advanced aerospace structural materials to upgrade gas turbine engine and airframe components. Additional areas of focus are synthesis of diamond films for thermal management in electronic packaging; insertion of state-of-the-art ceramics into military system components (bearings, armor, gas turbine engine components); precision machining of high strength alloys, composites and ceramics using laser and electron beam energy sources, flexible energy delivery systems, and process diagnostic tools. Flexible solid freeform manufacturing capabilities are being developed for high performance structural materials which will fabricate functional components directly from Computer Aided Design (CAD) files and not require part-specific tooling or operator intervention.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Demonstrated diamond film growth rates of greater than 150 microns per hour over 10 centimeter diameter area in a system which incorporates intelligent process control. Initiated diamond film manufacturing program for multiple chip modules.
- (U) Evaluated, in burner rig, ceramic composites supplied by various manufacturers for extended component use in a gas turbine environment.
- (U) Achieved enhanced performance of biosensors via manipulation of cellular 2nd messenger system.
- (U) Demonstrated hot isostatic pressing schedule to achieve full consolidation of 40% continuous fiber reinforced metal matrix composite specimens and demonstrated

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics
Technology

Project Number: MPT-01

Budget Activity: 1. Technology Base

Date: April 1993

- feasibility of roll bonding consolidation technique for composite sheets.
 - (U) Demonstrated feedback for intelligent control of chemical vapor deposition of silicon nitride coatings for carbon-carbon composites; transitioned technology to industrial coating manufacturer.
 - (U) Developed fiber placement head for thermoplastic composite synthesis.
 - (U) Developed preliminary design of flexible machine for polymer matrix composite fabrication.
 - (U) Initiated research to process microlaminate metallic composites, ceramic fibers and solid-free-formed ceramic composites for Department of Defense (DoD) applications.
 - (U) Established four advanced materials synthesis, processing and commercialization partnerships with the private sector.
 - (U) Demonstrated continuous titanium matrix deposition on spread alumina fibers and non-damaging substrate release of green metal matrix composites (MMC) monotape.
 - (U) Demonstrated Ceramic Matrix Composites (CMCs) with oxidative stability up to 2500°C using sheet silicate phases as the fiber debond layer.
- (U) FY 1993 Planned Program:
- (U) Demonstrate thermal management capability of high conductivity diamond films in an electronic package.
 - (U) Demonstrate 3 fold increase in diamond deposition rate (0.3 grams/hour).
 - (U) Provide 6 layer interconnect Multi Chip Module (MCM) manufacturing unit step yields and program plan to improve module yields to make diamond MCMs cost effective.
 - (U) Develop high throughput arrays for robotic screening of computer-designed military therapeutics.
 - (U) Further increase biosensor sensitivity and dynamic range by regulation of genetically transferred cell surface receptors.
 - (U) Demonstrate a five-fold increase in mean time between failures of ceramic hybrid bearings in air cycle machines used on jet aircraft.
 - (U) Demonstrate a 30% improvement in accuracy of a heat-seeking missile through the use of ceramic hybrid bearings in the infrared (IR) seeker.
 - (U) Demonstrate the fabrication of fibrous monolithic ceramics which combine the low cost component

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics
Technology

Project Number: MPT-01

Budget Activity: 1. Technology Base

Date: April 1993

fabrication characteristics of monolithic ceramics with the damage tolerant characteristics of Ceramic Matrix Composites (CMCs).

- (U) Initiate program to develop a logistic fuel cell for military installations.
 - (U) Demonstrate production of low oxygen content, polymer derived silicon carbide fibers with strengths of one gigapascal up to 3000°F.
 - (U) Demonstrate consistent ceramic fiber production - 400 KSI strength.
 - (U) Manufacture 1800 ft of 1-inch and 1250 ft of 6-inch wide, continuous fiber, metal matrix composite monotape.
- (U) FY 1994 Planned Program:
- (U) Develop a model for gas-phase manufacturing of copper-indium-diselenide (CIS) photovoltaic membranes for remote electric power generation.
 - (U) Demonstrate a five fold decrease in manufacturing costs of a 6-inch diameter diamond wafer.
 - (U) Demonstrate gene-specific inhibition of military specific disease bearing infectious agents.
 - (U) Evaluate duration/magnitude of immune response to ultrasonically altered infectious organisms.
 - (U) Demonstrate a three-fold increase in life of turbine nozzle components by replacing them with silicon nitride in an auxiliary power unit.
 - (U) Initiate a program to establish process parameters and diagnostic tools for flexible processing of materials.
 - (U) Develop methodology and designs for tooling systems for flexible delivery of energy for precision fabrication of parts.
 - (U) Demonstrate the quality and cost benefits resulting from the application of Intelligent Processing of Materials (IPM) to the manufacture of silicon carbide monofilament fibers.
 - (U) Demonstrate the solid freeform fabrication machine capability to produce engine quality silicon nitride components, with mechanical properties comparable to those manufactured by conventional methods.
 - (U) Initiate program on mathematical modeling of microstructural evolution during materials processing.
 - (U) Initiate program on smart material development for adaptive aerodynamic control surfaces.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-01

PE Title: Materials and Electronics
Technology

Budget Activity: 1. Technology Base

Date: April 1993

- (U) Demonstrate metal matrix composites as a material for thermal management in electronic packaging.
- (U) Demonstrate first order process model of the Carbon/Carbon Rapid Densification Process.
- (U) Test brassboard logistic fuel processor for fuel cell power plant.
- (U) Demonstrate rapid prototyping battery manufacturing capability.

D. (U) WORK PERFORMED BY: Major performers are: United Technologies Research Center, East Hartford, CT; General Electric Corporation, Schenectady, NY; Sandia Laboratories, Livermore, CA; Norton Company, Northboro, MA; Williams International, Walled Lake, MI; 3M Corporation, St. Paul, MN; Allied Signal Aerospace Company, Phoenix, AZ; Pratt & Whitney, West Palm Beach, FL; Lanxide Corporation, Newark, DE; General Dynamics, Groton, CT; and Raytheon Corporation, Tewksbury, MA.

E. (U) RELATED ACTIVITIES: Advanced Research Projects Agency's (ARPA's) research on Materials Processing is coordinated within DoD and with other federal agencies via the National Science Foundation-hosted Interagency Materials Group, Office of Science and Technology Policy Committee on Material (COMAT) and various topical workshops on structural materials and materials processing.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics
Technology

Project Number: MPT-02

Budget Activity: 1. Technology Base

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	FY 1992 <u>Actual</u>	FY 1993 <u>Estimate</u>	FY 1994 <u>Estimate</u>	To <u>Complete</u>	Total <u>Program</u>
MPT-02	Electronic Processing Technology 22,511	37,952	79,386	Continuing	Continuing
(MPT-03)	(14,634)*	(36,877)*			

*The associated FY 1993 and prior year funding and program accomplishments and plans for this project were included in Project MPT-03 and are shown here for continuity purposes.

B. (U) BRIEF DESCRIPTION OF PROJECT: This project develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, and materials for infrared devices. Areas of emphasis include high-performance analog-to-digital converters (ADCs), military optical processors, novel optoelectronic devices and modules, artificial neural network technology, and semiconductor process design and synthesis. Beginning in FY 1994, efforts previously included in MPT-03 are consolidated within this project. Also, efforts in ADCs and optoelectronics previously funded in 6.1 basic research have transitioned to this project starting in FY 1994. This microelectronics development project creates the technology base for advanced electronic and optoelectronic components to meet DoD needs in all DDR&E thrust areas.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Demonstrated process modules that performed fabrication steps for low-volume, state-of-the-art circuits.
- (U) Demonstrated closed-loop control of Microelectronics Manufacturing Science and Technology (MMST) processes.
- (U) Demonstrated 8-day cycle time on a 5-wafer MMST lot.
- (U) Initiated efforts to develop high-speed, low-power ADCs, in gallium arsenide (GaAs) heterojunction bipolar transistor (HBT) technology.
- (U) Demonstrated neural net system for recognizing electronic signal signatures.
- (U) Initiated procurement of Application Specific Electronic Module (ASEM) program.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E
PE Title: Materials and Electronics
Technology

Project Number: MPT-02
Budget Activity: 1. Technology Base
Date: April 1993

- (U) Demonstrated a non-destructively-read, non-volatile ferroelectric memory transistor. (MPT-03)
- (U) Fabricated optical associative memory module for field test in data base management. (MPT-03)
- (U) Demonstrated optical, binary-phase-only, matched-filter module for pattern recognition. (MPT-03).
- (U) Fabricated quantum-well lasers (lattice-matched and strain layers) for ultra-low thresholds. (MPT-03)

(U) FY 1993 Planned Program:

- (U) Demonstrate Microelectronics Manufacturing Science and Technology (MMST) fabrication cycle time and yield improvements on a 1000-wafer demonstration.
- (U) Demonstrate MMST fabrication flexibility by processing two distinct process flows.
- (U) Demonstrate MMST capability to fabricate an externally designed circuit.
- (U) Complete design of GaAs HBT ADCs for ultra-high-speed conversion of microwave signals to digital form for advanced signal processing.
- (U) Complete fabrication line assembly for HBTs.
- (U) Initiate effort to develop models applicable to 100 gigahertz (GHz) HBTs.
- (U) Develop neural nets for automatic target recognizer.
- (U) Demonstrate compact neural network sensing, tracking, and recognition system.
- (U) Complete development of acoustic charged transport chip (ACT) manufacturing capability.
- (U) Scale infrared substrate growth process to produce wafers with twice the single-crystal area.
- (U) Develop process for low-cost ferroelectric non-volatile memory. (MPT-03)
- (U) Demonstrate real-time, compact synthetic aperture radar (SAR) with spotlight mode. (MPT-03)
- (U) Demonstrate steering of wide-band radar beam with optical control module. (MPT-03)
- (U) Initiate university-industry optoelectronics centers. (MPT-03)

(U) FY 1994 Planned Program:

- (U) Test first iteration GaAs HBT-based analog-to-digital converters (ADCs) for sampling speed and dynamic range.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E
PE Title: Materials and Electronics
Technology

Project Number: MPT-02
Budget Activity: 1 Technology Base
Date: April 1993

- (U) Complete design of GaAs HBT-based ADC support components, such as multiplexers and demultiplexers.
- (U) Initiate effort to develop a design system for circuits operating above 10 GHz.
- (U) Demonstrate neural net target recognizer for specific aircraft platforms.
- (U) Demonstrate first neural net board-level systems.
- (U) Initiate development of neural network-based voice and pen commands for computer interfaces.
- (U) Demonstrate prototype neural network-based process control system.
- (U) Demonstrate fiber-optic-based bistatic radar.
- (U) Field demonstration of optical pattern recognition modules.
- (U) Field demonstration of real-time optical synthetic aperture radar (SAR) processors.
- (U) Develop integrated monolithic tunable laser arrays.
- (U) Develop packaged optoelectronic-microwave modules for microwave transmission.
- (U) Initiate efforts to develop low-cost optoelectronic module manufacturing technologies.
- (U) Develop optoelectronic packages that incorporate passive alignment techniques between fibers and component input/output (I/O).
- (U) Initiate effort to define methodologies to reduce the time and cost needed to design semiconductor processes and develop tools to address optimized cost modeling.

D. (U) WORK PERFORMED BY: Electronic Decisions Incorporated, Urbana, IL; Rockwell, Anaheim, CA; TRW, Los Angeles CA; Lincoln Lab, Lexington, MA; Hughes, Malibu, CA; Harris, Melbourne, FL; Texas Instruments, Dallas, TX; Westinghouse Electric, Baltimore, MD; and Stanford University, Palo Alto, CA.

E. (U) RELATED ACTIVITIES: The work is coordinated with Service research efforts through the Advisory Group on Electron Devices and via annual government-wide program reviews. These activities assure that no duplication of effort occurs.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-06

PE Title: Materials and Electronics
Technology

Budget Activity: 1. Technology Base
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
MPT-06	High Temperature Superconductivity (HTSC)				
	(26,446)*	35,461	37,788	Continuing	Continuing

*The associated FY 1992 funding and program accomplishments and plans are funded in PE 0602301E, Project ST-16 and are shown here for continuity purposes.

B. (U) BRIEF DESCRIPTION OF PROJECT: High temperature superconducting (HTS) materials have reached a stage of development when specific applications can be identified in thin-film electronic devices and circuitry for military avionics, with concomitant benefit to commercial electronics. The ARPA program is building specific insertions for radar and electronic detection systems with extremely wide bandwidth and dynamic range, general avionics, and airframe guidance subsystems, while continuing with the development of the underlying fabrication technology for thin films, bulk wire and other forms. Particular demonstrations include a switched filterbank for the B-1B radar warning receiver, superconducting electronic packages for Electronic Intelligence (ELINT) and electronic warfare suites in reconnaissance aircraft, and safe and economical devices for riveting and clamping sheet metal sections for aircraft manufacturing.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Production underway for bismuth-based HTS wire with higher transition temperature than yttrium barium copper oxide (YBCO), exhibiting current carrying capability of 10,000 amperes/cm² over kilometer lengths.
- (U) Demonstrated thin-film radio frequency components including filters, delay lines, resonators, etc., appropriate for wafer-scale integration to build superconducting transceiver.
- (U) Demonstrated HTS microwave component operation in prototype Navy satellite space experiment.
- (U) Initiated development of superconducting interconnects in multichip modules for performance improvement and enhanced manufacturing capability, and increased yield in high packing density requirements.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics
Technology

Project Number: MPT-06

Budget Activity: 1. Technology Base

Date: April 1993

(U) FY 1993 Planned Program:

- (U) Demonstrate operation of multichip modules which employ High Temperature Superconductivity (HTS) interconnects in digital receiver circuits.
- (U) Demonstrate integrated HTS RF components in electronic warfare and communications systems.
- (U) Initiate active, digital, cryoelectronics development based on flux-trapped quantum logic, applied to high resolution analog/digital (A/D) converter or digital radio frequency memory.

(U) FY 1994 Planned Program:

- (U) Demonstrate functioning multichip module with superconducting interconnects utilizing 40 or more integrated circuit chips, showing performance enhancement, and simplicity of manufacturing.
- (U) Demonstrate state-of-the-art radar warning receiver (for B-1B bomber) with switchable HTS protective filters to enable system operation in a dense signals environment.
- (U) Transition technology to advanced development programs in the Navy and Air Force, to build sensors for air-to-air missile seekers, radar receivers incorporating superconducting channelized filters and stabilized oscillators, and high performance electronics using multichip modules with superconducting interconnects.

D. (U) WORK PERFORMED BY: Major performers include: Superconductor Technologies, Inc., Goleta, CA; Conductus, Inc., Sunnyvale, CA; Massachusetts Institute of Technology, Cambridge, MA; nChip, San Jose, CA; E-Systems, Falls Church, VA; Honeywell Corporation, Minneapolis, MN; Ceramic Process Systems, Milford, MA; Boeing, Seattle, WA; Westinghouse Corporation, Baltimore, MD; and DuPont Corporation, Wilmington, DE.

E. (U) RELATED ACTIVITIES: Research is coordinated within DoD and with other federal agencies via the Office of Science and Technology Policy (OSTP) Committee on Materials (COMAT), HTS Coordinating Committee, the National Science Foundation (NSF) hosted Interagency Materials Group, and numerous workshops involving industry, universities and government laboratories.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATION AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602790E
PE Title: SBIR Program

Budget Activity: 1. Technology Base
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
SR-01	Small Business Innovation Research (SBIR)				
	12,115 *	16,182	**	Continuing	Continuing

*FY 1992 funding in PE 0605502E.

**FY 1994 funding in PE 0603570E.

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program is mandated by the Small Business Development Act of 1982, PL 97-219, PL 99-443 and PL 102-564. It is designed to stimulate technological innovation, strengthen the role of small business in meeting military and dual-use research and development needs, foster and encourage participation by minority and disadvantaged persons in technological innovation, and increase the commercial application of DoD-supported research and development results.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Over 70 Phase I and 30 Phase II contracts awarded to small businesses.

(U) FY 1993 Planned Program:

- (U) ARPA is participating in SBIR solicitations with 119 topics for small businesses.

(U) FY 1994 Planned Program:

- (U) ARPA will solicit additional SBIR proposals.

D. (U) WORK PERFORMED BY: Over 100 small businesses.

E. (U) RELATED ACTIVITIES: The SBIR Program complements ongoing ARPA research programs.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Budget Activity: 2. Advanced Technology
 PE Title: Experimental Evaluation Development
of Major Innovative Date: April 1993
Technologies

A. (U) RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1992 Actual</u>	<u>FY 1993 Estimate</u>	<u>FY 1994 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
EE-21 Close Combat	10,386	0	0	0	375,231
EE-23 Enhanced Fighter Maneuverability	12,800	8,758	0	0	103,194
EE-24 ASTOVL	0	4,770	19,712	Continuing	Continuing
EE-27 Advanced Space Technology Program	30,340	14,711	30,213	Continuing	Continuing
EE-30 Smart Weapons Application Program	27,800	7,203	0	0	50,131
EE-34 Guidance Technology	7,538	13,260	7,779	8,344	51,142
EE-36 Advanced ASW Technology	11,814	10,721	13,680	Continuing	Continuing
EE-37 Advanced Simulation	33,279	43,483	53,993	Continuing	Continuing
EE-39 Unmanned Undersea Vehicle Systems	18,679	15,880	17,952	Continuing	Continuing
EE-40 Critical Mobile Targets (56,040)		34,724	105,103	Continuing	Continuing
EE-41 Air Defense Initiative 1(95,645)		1(32,018)	27,717	Continuing	Continuing
EE-43 Alternative Power Sources	0	54,539	0	0	54,539
EE-44 Wingship	0	5,000	0	0	5,000

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Budget Activity: 2. Advanced Technology
PE Title: Experimental Evaluation Development
of Major Innovative Date: April 1993
Technologies

EE-45	Global Grid Communications				
	0	0	20,881	Continuing	Continuing
EE-CLS/ADI	96,859	73,519	215,168	Continuing	Continuing
	¹ (106,000)	¹ (129,169)			
Total DARPA	249,495	286,568	512,198	Continuing	Continuing
Total ADI	201,645	161,187	0		
Total	<u>451,140</u>	<u>447,755</u>	<u>512,198</u>		

¹Previously funded in OSD PE 0603741D.

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element is dedicated to the demonstration and evaluation of advanced research and development concepts. Beginning in FY 1994, funding in this program element reflects the functional transfer of the Air Defense Initiative (ADI) from OSD to ARPA. In addition, the FY 1994 proposed budget reflects the transfer of the Balanced Technology Initiative (BTI) programs from OSD to ARPA and the subsequent inclusion of these programs within ARPA's affiliated technology or programmatic thrusts. The programs contained in Project EE-37, Advanced Simulation reflect the Department's initiative to support dual-use technologies.

(U) In addition to the individual project descriptions, this program element includes the FY 1993 congressional initiatives for Alternative Power Sources and Wingship.

(U) The Alternative Power Sources project supports the development of electric, hybrid, and natural gas vehicles. It explores their potential to enable the armed forces to achieve energy cost savings, comply with environmental requirements, and meet mission objectives.

(U) The Wingship project is investigating the feasibility of developing a large heavy lift air/sea vehicle that could provide the DoD with the capability to rapidly deploy forces in a global environment.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-24
Budget Activity: 2. Advanced
Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title:

<u>Popular</u> <u>Name</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
EE-24	ASTOVL				
	0	4,770	19,712	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: In response to a Department of the Navy desired operational capability, the ASTOVL/CTOL Common Affordable Lightweight Fighter project was originated by ARPA to jointly investigate the technical feasibility of designing a single engine lightweight, affordable aircraft to conduct missions currently performed by the AV-8B, F-16, and F/A-18. As envisioned, the aircraft would be of modular design, providing for an Advanced Short Takeoff, Vertical Landing (ASTOVL) variant for use by the Navy and Marine Corps, and a Conventional Takeoff and Landing (CTOL) variant for use by the Air Force. These variants would share a common engine, airframe and avionics. The ASTOVL-enabling propulsive lift system would be removed from the Air Force variant and replaced with additional fuel capacity. Major performance goals for the operational aircraft and demonstrator include: Weight Empty: <24,000lb; Size: <F-18C; Powerplant: (Single Engine) Derivative of the F-119 or YF-120 Advanced Tactical Fighter Engine (ATFE) augmented in the STOVL variant by a shaft or gas-driven lift fan; maneuvering and airspeed flight envelope equal to or greater than the F-18; Flyaway cost: <F-18C.

(U) The program consists of four phases. Phase I, which has been completed, investigated propulsive lift concepts. Phase II will validate critical technologies relevant to the two most promising propulsive lift concepts. ARPA has awarded two Phase II contracts, each investigating a different augmented lift concept. Each contract will address the system design and operational performance potential of a particular concept. This will be accomplished by performing system design and capability goal trade-off analyses. Additionally, this effort will explore the critical powered lift transition corridor using large scale model demonstrations. Full or large scale demonstrations of selected critical propulsion components will similarly be required. The degree of hardware development difficulty and hardware manufacturability will be analyzed, and where practical proven, in parallel with the maturation of the aircraft design. The goal of this approach is not

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-24
Budget Activity: 2. Advanced
Technology Development
Date: April 1993

just to show that traditional engineering and manufacturing methods can be employed to produce the proposed design, but more importantly, to encourage developing and proving innovative processes for reducing engineering and manufacturing costs. If Phase II is successful, a single propulsive lift concept will be selected and Phase III will consist of design and fabrication of a full-scale technology demonstrator aircraft. Phase IV will consist of flight testing of the demonstrator aircraft.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments: Not applicable.

(U) FY 1993 Planned Program:

- (U) Begin Critical Technology Validation (Phase II) of the project.
- (U) Award two contracts: one to investigate the Shaft Coupled Lift Fan Concept and another to investigate the Gas Coupled Lift Fan Concept.
- (U) Conduct operational aircraft concept design refinement.

(U) FY 1994 Planned Program:

- (U) Conduct analysis and demonstration of affordability-enhancing technologies and processes.
- (U) Construct large scale wind tunnel models.
- (U) Construct large scale propulsion system components for rig testing.

(U) Program to Completion:

- (U) Complete Critical Technology Validation (Phase II)
- (U) Design and fabricate full-scale technology demonstrator aircraft (Phase III)
- (U) Conduct flight testing of the demonstrator aircraft (Phase IV)

D. (U) WORK PERFORMED BY: Contracted work is being performed by Lockheed Advanced Development Company, Palmdale, CA and McDonnell Douglas Aerospace, St. Louis, MO; NASA Ames Research Center, Moffett Field, CA, is providing technical support.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: FY 1993 funding was provided by Congressional action.

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: <u>#0603226E</u>	Project Number: <u>EE-24</u>
PE Title: <u>Experimental Evaluation of</u>	Budget Activity: <u>2. Advanced</u>
<u>Major Innovative Technologies</u>	<u>Technology Development</u>
	Date: <u>April 1993</u>

F. (U) PROGRAM DOCUMENTATION: Joint ARPA/U.S. Navy project established by Memorandum of Agreement dated 16 March 1993.

G. (U) RELATED ACTIVITIES: Program Element: 0603217N (Air Systems Advanced Technology Development).

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Planned</u>	<u>Milestones</u>
Apr 94	Model Designs Complete
Oct 95	Model Fabrication Complete
Jan 96	Commence Wind Tunnel Test
Sep 96	Phase II Final Report

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Project Number: EE-27
PE Title: Experimental Evaluation of Budget Activity: 2. Advanced
Major Innovative Technologies Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Advanced Space Technology Program

<u>Popular</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>FY 1994</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
EE-27	Advanced Space Technology Program				
	30,340	14,711	30,213	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: The Advanced Space Technology Program (ASTP) is aimed at enhancing access to space and reducing the cost of space systems. The ASTP has several components: Satellite subsystems and payload technologies; PEGASUS Air-Launched Space booster and the TAURUS ground-transportable Standard, Small Launch Vehicle; demonstration of lightweight satellites; and several advanced technology demonstrations (ATDs) supporting the DDR&E Global Surveillance and Communications (GS&E) thrust.

(U) Enabling subsystem technology developments include autonomous navigation; attitude control; communications; tactical surveillance; advanced computing; power sources; and other lightweight components. These form the foundation for development of a scalable, high-performance Advanced Technology Standard Satellite Bus (ATSSB) providing improved payload mass fraction and a simplified "bolt-on" interface to support operationally useful, advanced payloads in a wide range of orbits at greatly reduced cost and acquisition time.

(U) ARPA is beginning the brassboard development phases of two possible demonstration payloads. Both these payloads can be integrated into the ATSSB for space demonstrations. Specific activities are as follows:

(U) Extremely High Frequency (EHF) lower cost, communication technologies (ASTEC) will be developed to support the ASD/C³I MILSATCOM modernization decision. The emphasis is to reduce the system acquisition costs and the "time-to-market" of future advanced communications satellites. In addition, affordable, robust hyperspectral/multispectral sensor technologies (CAMEO) will be developed and assessed. Their intent is to service a number of DoD and commercial users with a minimal set of sensor assets. These technologies could be integrated into a payload and launched in time to satisfy the National LANDSAT Policy Act which mandates an Advanced Technology Demonstration in space by 1997.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-27

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

(U) The Insertion into MILSATCOM Products of Advanced Communications Technology (IMPACT) Program will apply advanced technologies to reduce the life-cycle cost of the MILSATCOM terminal segment by reducing size, weight and power consumption while increasing reliability and performance.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Continued Satellite Component Technology development.
- (U) Completed MACSAT, MICROSAT satellite demonstration.
- (U) Transitioned MACSATs/ground terminals to Navy/Air Force.
- (U) Continued development of DARPASAT.
- (U) Continued development of the TAURUS launch vehicle.

(U) FY 1993 Planned Program:

- (U) Complete satellite component technology developments.
- (U) Support space demonstration of component technologies.
- (U) Transition PEGASUS Air-Launched Vehicle to the Air Force.
- (U) Launch the TAURUS transportable launch vehicle.
- (U) Launch DARPASAT satellite on TAURUS.
- (U) Proceed with contract award of payload system elements.
- (U) Initiate the IMPACT program

(U) FY 1994 Planned Program:

- (U) Complete the DARPASAT demonstration program.
- (U) Transition the DARPASAT to user.
- (U) Transition TAURUS launch vehicle to the Air Force.
- (U) Initiate development of the ATSSB.
- (U) Proceed with contract award of payload system elements.
- (U) Continue the IMPACT Program.

(U) Program to Completion:

- (U) Conduct qualification testing of the ATSSB.
- (U) Continue development of payload system elements.
- (U) Continue the IMPACT Program.
- (U) Launch and demonstrate payloads.
- (U) Field and demonstrate IMPACT terminal testbed.

D. (U) WORK PERFORMED BY: Orbital Sciences Corporation, Fairfax, VA; Space Applications Corporation, Vienna, VA; Ball Aerospace Corporation, Boulder, CO; Honeywell, Minneapolis, MN; Hughes Space and Communications, Los Angeles, CA; Massachusetts Institute of Technology/

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-27
Budget Activity: 2. Advanced
Technology Development
Date: April 1993

Lincoln Laboratory, Lexington, MA; Phillips Laboratory, Kirtland Air Force Base, NM; Rome Laboratory, Rome, NY; Air Force Space and Missile Systems Center, Los Angeles, CA; Western Test Range, Vandenberg Air Force Base, Communications Electronics Command, Fort Monmouth, NJ; and others.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: The ATSSB start had been delayed until FY 1994. The Advanced Technology Demonstration (ATD) mentioned in the previous Summary have been reduced in scope, restructured and formalized into the ASTEC, CAMEO and IMPACT Programs.

F. (U) PROGRAM DOCUMENTATION:

- (U) U.S. Air Force/DARPA MOA dated 1988
- (U) U.S. Army/DARPA MOA dated 1990
- (U) SDIO/DARPA MOA dated 1990
- (U) DARPA/U.S. Air Force TAOS MOA dated 1992
- (U) DARPA/Joint Services ASTEC MOA (in process)
- (U) DARPA/Joint Agency CAMEO MOA (in process)

G. (U) RELATED ACTIVITIES: ARPA has MOAs with the Army, Navy, Air Force, SDIO and others for ARPA space technology projects. The ASTEC Program is a joint development with the Army, Navy and Air Force. The CAMEO Program is a potential joint Agency technology demonstration. ARPA has developed the Joint Program Management Plan (PMP) for the DDR&E demonstrations. The existence of this joint PMP ensures there is no unnecessary duplication of effort within the Department of Defense. The related Program Element contributing to the ASTEC program in FY 1994 is: 0602702F - Command, Control and Communications, Air Force.

H. (U) OTHER APPROPRIATIONS FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Planned</u>	<u>Milestone</u>
May 93	Transition PEGASUS to Air Force
Summer 93	First launch of TAURUS (SSLV)/DARPASAT
Summer 94	Complete demonstration of DARPASAT
Aug 93	Award contracts for IMPACT
Aug 93	Technology development completions
Jan 94	Award contracts for ATSSB and critical payload elements for ASTEC and CAMEO
Sep 95	Critical Design Review for payloads
Dec 96	Qualification testing complete for ATSSB

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: <u>#0603226E</u>	Project Number: <u>EE-34</u>
PE Title: <u>Experimental Evaluation of</u>	Budget Activity: <u>2. Advanced</u>
<u>Major Innovative Technologies</u>	<u>Technology Development</u>
	Date: <u>April 1993</u>

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Guidance Technology

<u>Popular</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>FY 1994</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
EE-34					
	Guidance Technology				
	7,538	13,260	7,779	8,344	51,139

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: Fire-and-Forget stand-off weapons require high-precision navigation capabilities to effectively eliminate prime targets with minimal collateral damage in the target area. This program develops the high-accuracy, low cost navigation subsystems technologies required for the next generation stand-off weapons, and for upgrading current weapon inventories. In addition, these capabilities can provide precision attitude control for space-based and theater search, surveillance and reconnaissance platforms. Potential transition opportunities include the AGM-130, the Tomahawk Land Attack Missile Block IV Upgrade, Minuteman, and unmanned, long endurance airborne battlefield support vehicles. Specific research areas include: Advanced all solid-state, low cost navigation-grade miniature inertial measurement unit (MIMU) systems; and multi-channel-on-a-chip, high dynamics, miniature Global Positioning System (GPS) receivers (MGRs).

(U) The GPS Guidance Package is the integration of the MGR, three MIMUs and an advanced navigation computer into a low-cost, precision navigation system. Phase 1 addresses the technology issues involved in: (1) miniaturizing inertial-grade IMUs into a compact, manufacturable configuration; and (2) developing a multi-channel-on-chip, high dynamics MGR. Upon successful demonstration of these technologies, they will be integrated into a test fixture-type brassboard for field testing and evaluation by ARPA and Air Force. Phase 2 will demonstrate the compact, affordable packaging of these technologies into a form compatible with a large range of unmanned and manned platforms, satellites and weapon systems. These latter units will be configured to provide precision guidance to the DoD's Short Range UAV.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Executed a Memorandum of Agreement with the Air Force for a joint development program.
- (U) Demonstrated Light Source power and lifetime levels;

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-34

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

- 5-channel/chip signal processing chips; and silicon accelerometer technology necessary for Phase 2.
- (U) Completed GPS Guidance Package (GPP) brassboard Critical Design Reviews and began test fixture/brassboard development.
- (U) FY 1993 Planned Program:
 - (U) Integrate Miniature GPS Receiver (MGR) and Miniature Inertial Measurement Unit (MIMU) technologies in hot testbed and test its static integrated performance.
 - (U) Conduct Preliminary Design Review of AF brassboards.
 - (U) Begin test fixture/brassboard fabrication.
 - (U) Complete development of Multi-Function Self-Aligned Gate technologies.
- (U) FY 1994 Planned Program:
 - (U) Conduct Phase 1 contractor field evaluation.
 - (U) Delivery of Phase 1 brassboard to ARPA agent for Government testing.
 - (U) Complete fabrication of AF GGP brassboards.
 - (U) Begin Phase 2 Packaging effort to further reduce GGP in size, weight, power drain and cost.
- (U) Program to Completion:
 - (U) Complete Government Laboratory and field evaluations of GGP Phase 1 brassboards.
 - (U) Conduct GGP Phase 2 Preliminary, Critical and Test Readiness Reviews Design Reviews.
 - (U) Complete fabrication of GGP Phase 2 brassboards and laboratory/field test the units.

D. (U) WORK PERFORMED BY: NRaD, San Diego, CA; Charles Stark Draper Laboratory, Boston, MA; RAND Corporation, Washington, DC; Galaxy Scientific Corporation, Philadelphia, PA; Litton Industries, Woodlawn Hills, CA; Rockwell International/Collins Division, Cedar Rapids, IA; and ITT, Orlando, FL.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: The increase is the result of Congressional add for the Multi-Function Self-Aligned Gate (MSAG).

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: The Air Force is jointly funding GGP Phase

UNCLASSIFIED

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-34

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

1 with ARPA from PE 0602204F, Avionics, and PE 0603311F, Ballistic Missile Technology. No other organizations are developing and integrating technologies for high-precision, tightly-coupled, advanced solid-state MIMU/MGR equipment.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

GGP Phase 1B Award	3Q FY 1992
GGP Test Readiness Review	3Q FY 1993
Phase 1 Contractor brassboard Testing	4Q FY 1993
Phase 1 Brassboard Delivery	1Q FY 1994
Government Brassboard Tests Begin	1Q FY 1994
GGP Phase 2 Award	3Q FY 1994
GGP Phase 2 PDR	3Q FY 1995
GGP Phase 2 CDR	2Q FY 1996
Phase 2 Contractor Testing	3Q FY 1997
Phase 2 Brassboard Delivery	1Q FY 1998
Government Brassboard Tests Begin	1Q FY 1998

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-36
Budget Activity: 2. Advanced
Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Advanced Anti-Submarine Warfare (ASW) Technology

<u>Popular</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>FY 1994</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
EE-36	ASW Technology				
	11,814	10,721	13,680	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: As ASW requirements changed from deep water to shallow water regional conflicts, the focus of the project shifted from examining innovative technologies for operations in deep ocean environments to those employed in the acoustically complex shallow water environment. This project develops technologies that will significantly enhance naval and maritime capabilities in littoral warfare environments.

(U) The project focuses on three areas of development: sonar technology, ASW scene management, and periscope detection. The Sonar Technology project demonstrates applications of advanced object detection, classification, and localization technologies using high performance computing (HPC). In particular, the project focuses on demonstrating autonomous target detection, localization, and tracking algorithms from distributed active and passive sensors. The project will also produce a demonstration of multi-sensor fusion through automatic detection and classification algorithms for combining non-acoustic sensor data with both active and passive acoustic data; and provide a capability to display, geographically, a complete description of the maritime tactical scene. In addition, the project develops and demonstrates vertically directive low frequency sources of both a continuous and impulsive nature. The ASW scene management project will develop signal processing techniques to integrate real-time information with background intelligence to provide a complete picture of the shallow water operational situation. The Periscope Detection project will determine the exploitability of ultra-wideband radar for periscope detection.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Demonstrated Autonomous Target Acquisition and Relocation System (ATARS) relocation performance (duct environment).

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-36

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

- (U) Conducted ATARS shallow water algorithm development and preliminary testing.
 - (U) Completed multi-sensor fusion requirements specification.
 - (U) Initiated multi-sensor fusion algorithm development.
 - (U) Conducted initial periscope detection experiments.
- (U) FY 1993 Planned Program:
- (U) Characterize detection, classification, and localization performance (shallow water environment).
 - (U) Analyze shallow water area characterization test data and update processing algorithms.
 - (U) Develop shallow water low frequency (LF) acoustic sources for employment from tactical aircraft and ships.
 - (U) Demonstrate multi-sensor fusion algorithm.
 - (U) Determine the exploitability of periscope resonance.
- (U) FY 1994 Planned Program:
- (U) Develop sensors and arrays for shallow water environment.
 - (U) Develop and conduct at-sea testing of an active acoustic system for shallow water environments employing receiving arrays of various configurations and locations (multistatic active acoustic system).
 - (U) Conduct at-sea wideband radar experiment for periscope detector.
 - (U) Initiate the development of shallow water total scene management system that provides the operational commander with complete information on the tactical, acoustical, and bathymetric conditions of the area of operations.
 - (U) Develop and conduct testing of low frequency (LF) acoustic sources.
- (U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: Arete Associates, San Diego, CA; BBN Systems and Technologies, Arlington, VA; ESL Inc., Sunnyvale, CA; Alliant TechSystems, Arlington, VA; Raytheon Company, Portsmouth, RI; SRI International, Arlington, VA; ORINCON Corporation, San Diego, CA; Science Applications International Corporation, New London, CT; Applied Research Laboratory/University of Texas, Austin, TX; and Radix Systems, Inc., Gaithersburg, MD.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-36

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: As discussed above, the focus of the project shifted from developing technologies for system operations in deep ocean environments to those employed in the acoustically complex shallow water environment. Data fusion and signal processing technology development is now being emphasized in order to enhance situation assessment in this environment. In addition, acoustic signal sources are being adapted for use in this environment. Shallow water scene management and signal processing systems are also being developed.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: This program has been fully coordinated with the following programs to ensure no duplication of effort:

- (U) Surveillance, signal processing and acoustic science technology are being developed under Program Element 0602702E, Tactical Technology.
- (U) Supporting high performance computing efforts are ongoing under Program Element 0602301E, Computing Systems and Communications.
- (U) Acoustic Signal Processing efforts are being pursued under Program Element 0602702E, Tactical Technology.
- (U) Navy Enhanced Advanced Technology Demonstration (ATD) (Shallow Water Technology Initiative), Program Element 0603555N.
- (U) Navy Advanced Anti-Submarine Warfare (ASW) Technology, Program Element 0603747N.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
FY 93	Complete Autonomous Target Acquisition and Relocalization System (ATARS) performance characterization in a shallow water environment.
FY 94	Conduct multistatic active/passive system testing demonstration in a shallow water environment.
FY 94	Complete laboratory-scale testing of low frequency (LF) acoustic sources.
FY 94	Complete resonance periscope detector feasibility testing.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Project Number: EE-37
PE Title: Experimental Evaluation of Budget Activity: 2. Advanced
Major Innovative Technologies Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

<u>Project Title:</u> Advanced Simulation					
<u>Popular</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>FY 1994</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
EE-37	Advanced Simulation				
	33,279	43,483	53,993	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: The Advanced Distributed Simulation program develops advanced interoperable technologies to enable a distributed, seamless warfighting simulation environment at the weapon level of detail for the Department of Defense (DOD). The ultimate goal is to provide the tools and standards necessary to create, on demand, a robust synthetic theater of war capable of supporting the following functions: Joint/Service readiness training; Joint/Service Doctrine refinement and development; requirements analysis; design, prototyping and manufacturing; and contingency planning, operations, after action review, and historical analysis. The focus is on the development and integration of key technologies such as environmental representation, intelligent computer generated forces, communications (advanced networking) and data flow, range instrumentation, and computer image generation. As technologies mature, they will be demonstrated and tested in joint theater war exercises of increasing size, complexity and utility which includes all forms of tactical simulation on a seamless electronic battlefield.

(U) The environmental programs concentrate on the creation of the digital environments for simulation including terrain representation, weather, diurnal variations and dynamic terrain. The intelligent computer-generated forces creates a scalable computer-generated military force that is representative and behaviorally accurate. The communications and data flow project concentrates the technology development to support 100,000 locations interoperating with each other in perceptible real time. The range instrumentation project addresses the problem of interfacing the live world to the synthetic environment. The computer image generation program (CIG) emphasizes the need for order of magnitude increase in CIG performance along with an order of magnitude decrease in cost.

(U) The Advance Simulation Technology developments support the DDR&E Science and Technology Thrust Panel for Synthetic Environments, Readiness and Training.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-37

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Demonstrated interoperation of multiple wargaming models in a secure distributed network between Europe, selected locations in the continental United States and Korea.
- (U) Initiated development of a prototype Intelligent Gateway supporting interoperation of aggregated simulation models with networks of individual weapons platforms, simulators and simulations.
- (U) Initiated development of CINC-level testbed combining distributed C⁴I with advanced mission planning and simulation capabilities.
- (U) Initiated development of low cost high performance networked aviation simulation and knowledge engineering for aviation intelligent automated forces.
- (U) Demonstrated man-in-the-loop simulation as a tool for acquisition streamlining.
- (U) Captured a stressing critical mobile target scenario and associated system architecture/statistical representation from recent Desert Storm experience.
- (U) Initiated a capability to network real mobile objects in a field environment for battalion-level simulation.

(U) FY 1993 Planned Program:

- (U) Demonstrate technical principles for development of technologies supporting networked interoperation representing 10,000 entities as individuals on the synthetic battlefield.
- (U) Development of rapid terrain database generation capability.
- (U) Complete critical mobile target technology simulation/development network testbed with six major sites.
- (U) Demonstrate initial prototype of intelligent computer generated automated forces with adaptive behavior for developmental evaluation of experimental aviation systems.
- (U) Continue development of a simulation/rehearsal node integrated with a CINC-level C⁴I system.
- (U) Demonstrate engineering feasibility of a low cost computer image generators for virtual battlefield simulation.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-37

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

- (U) Demonstrate initial point-to-point gateways required to network instrumented real systems, ranges virtual simulators/simulations and constructive simulations.
- (U) FY 1994 Planned Program:
 - (U) Demonstrate expanded technologies supporting 10,000 entities as individuals on the synthetic battlefield, and the interoperation of higher-level aggregated simulation with networks of individual platform level simulators and battalion-level intelligent automated forces.
 - (U) Demonstrate prototype rapid terrain generation system capability to produce 100K square terrain in 14 days.
 - (U) Demonstrate working intelligent computer generated automated forces.
 - (U) Demonstrate man-in-the-loop simulation in support of accelerated development and testing.
 - (U) Demonstrate interoperation of simulated warfighting environment with service C³I systems in large-scale simulated maneuver exercises.
 - (U) Demonstrate integration of virtual warfighting simulation and instrumented ranges.
 - (U) Demonstrate interactivity of high performance aviation in virtual simulation.
- (U) Program to Completion:
 - (U) Demonstrate a Joint Synthetic Theater of War supporting seamless land/sea/air warfighting simulation environment capable of representing 100,000 entities operating with a high degree of realism, fully integrated and supporting service and joint operational concepts.
 - (U) Transition simulation in acquisition process to using weapon system development organizations.
 - (U) Transition to services embedded, interoperable simulation capability spanning virtual (networked simulators), constructive (aggregate-level wargames), and real systems.
 - (U) Demonstrate proof of principle capability leading to low cost computer image generation for simulation.
 - (U) Demonstrate division level ground intelligent automated forces.

D. (U) WORK PERFORMED BY: Bolt, Baranek, and Newman, Cambridge, MA;
Los Alamos National Laboratory, NM; MITRE Corporation, McLean, VA; SRI

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Project Number: EE-37
PE Title: Experimental Evaluation of Budget Activity: 2. Advanced
Major Innovative Technologies Technology Development
Date: April 1993

International, Menlo Park, CA; and University of Central Florida, Orlando, FL.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: The FY93 decrease reflects a program re-scope based on technology availability and deferral of the Light Contingency Vehicle (LCV) simulation program.

F. (U) PROGRAM DOCUMENTATION: A memorandum of agreement has been completed with CINC, CENTCOM to support operational mission planning. Further, a memorandum of agreement with various Army agencies is in final staffing. All operational secure nodes on the Defense Simulation Internet have been certified and accredited.

G. (U) RELATED ACTIVITIES: Related work in technology development is closely coordinated with the Defense Modeling and Simulation Office to ensure that unnecessary duplication does not occur. Army funding is from PE 0604715A, Non-Systems Training Devices.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Planned</u>	<u>Milestones</u>
Mar 93	Complete Phase I critical mobile target simulation.
Jun 93	Demonstrate working intelligent automated forces for aircraft.
Sep 93	Demonstrate joint simulation environment with high performance distributed simulation for acquisition and training.
Mar 94	Demonstrate communications technologies supporting 10,000 weapons platforms as individual objects on the synthetic battlefield.
Jun 94	Demonstrate man-in-the-loop simulation.
Sep 94	Demonstrate improved intelligent automated forces.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-39
Budget Activity: 2. Advanced
Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Unmanned Undersea Vehicle (UUV) Systems

<u>Popular</u> <u>Name</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
UUV/Mine Countermeasures (MCM)	18,679	15,880	17,952	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: The stockpile of underwater mines and stealthy nuclear and non-nuclear submarines throughout the world present a threat in both littoral warfare and strategic warfare situations. In the Unmanned Undersea Vehicle (UUV) Project fully autonomous, maritime UUV systems for near land warfare are being developed and demonstrated. Work under this project is focused in three areas: mine countermeasures (MCM), deployable surveillance systems (DSS), and UUV enabling technologies.

(U) In the MCM area, autonomous systems for detection and neutralization of mines are being developed. The Mine Search System (MSS) has demonstrated a basic minehunting capability that can survey an area for mines or lead a host vessel around a mined area and is transitioning to the Navy. The Autonomous Minehunting and Mapping (AMM) System will demonstrate the capability to autonomously locate and classify mines with sufficient precision for detailed mapping and subsequent reacquisition by a neutralization system. Once developed, this capability will also be applicable for commercial undersea environmental survey and sampling.

(U) In the deployable surveillance systems (DSS) area, underwater sensor systems for surveillance (of mines, surface ships and submarines) are being developed that can be rapidly deployed by an Unmanned Undersea Vehicle (UUV). Technologies currently being initiated are multi-sensor arrays containing acoustic and non-acoustic sensors and an in-situ signal processing capability.

(U) UUV enabling technologies being addressed include a high energy density fuel cell system to be used for UUV propulsion, underwater communications, and compact, high precision inertial navigation.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-39
Budget Activity: 2. Advanced
Technology Development
Date: April 1993

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Demonstrated underwater laser communications system.
- (U) Completed Mine Search System (MSS) mine avoidance demonstration.
- (U) Demonstrated improved navigation for MSS mission.
- (U) Demonstrated 20-cell proton exchange membrane fuel cell for over 2100 hours; completed preliminary design review of the aluminum-oxygen fuel cell.

(U) FY 1993 Planned Program:

- (U) Complete MSS Program and transition to Navy.
- (U) Develop and implement automated mapping process.
- (U) Develop technology for autonomous vehicle operations in surf zone.
- (U) Fabricate multi-sensor fusion testbed and develop fusion algorithms.
- (U) Develop initial acoustic communications network capability.
- (U) Conduct proton exchange membrane fuel cell power plant demonstration; complete testing of aluminum-oxygen power system components, followed by testing of three and nine cell configurations.
- (U) Demonstrate advanced acoustic communications between Unmanned Undersea Vehicles (UUVs).
- (U) Investigate potential for underwater magnetic communications.

(U) FY 1994 Planned Program:

- (U) Conduct at-sea Autonomous Minehunting and Mapping (AMM) demonstration with UUV.
- (U) Develop technology for autonomous bottom-crawling vehicles.
- (U) Develop and fabricate a multi-sensor array tethered prototype system.
- (U) Complete design and development of the acoustic communications network.
- (U) Demonstrate complete UUV fuel cell power systems with reactant supply systems.
- (U) Develop underwater magnetic communications system for surf zone command-activated mine neutralization.
- (U) Test atomic interferometer inertial instrument.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-39

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

(U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: Charles Stark Draper Laboratory, Cambridge, MA; Applied Research Laboratory, University of Texas, Austin TX; International Fuel Cells, South Windsor, CT; Loral Defense Systems, Akron, OH; Woods Hole Oceanographic Institution, Woods Hole, MA; and Lockheed Missiles & Space Company, Inc., Sunnyvale, CA.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: The Fuel Cell brassboard power system demonstration has been delayed from November 1993 to September 1994 due to unforeseen technical difficulties.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: The Navy established an Unmanned Undersea Vehicles (UUV) Program Management Office (PMO 403) to transition these projects to the Navy.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Apr 93	Complete Mine Search System (MSS). Transition to Navy.
Apr 94	Begin autonomous minefield mapping at-sea testing.
Jun 94	Demonstrate brassboard atomic interferometer navigator.
Sep 94	Complete brassboard fuel cell power system demonstration.
Sep 94	Demonstrate acoustic communications network.
Sep 94	Complete precision navigation system development.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Project Number: EE-40
PE Title: Experimental Evaluation of Budget Activity: 2. Advanced
Major Innovative Technologies Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Critical Mobile Targets (WAR BREAKER)

<u>Popular</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>FY 1994</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
EE-40	Critical Mobile Targets (WAR BREAKER)				
	0	34,724	105,103**	Continuing	Continuing
	(56,040)*	(7,203)*			

*The associated FY92 and FY93 funding and program accomplishments incorporate Project RT-01 (PE #0603227E) and Project EE-30 (PE #0603226E).

**Includes \$4.4 million for the continuation of effort initiated in OSD PE #0603737D, Balanced Technology Initiative.

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: Prosecution of time-critical fixed and mobile targets has long been a concern of the Services. Our experience in Desert Storm has dramatically demonstrated our current inability to prosecute these targets, particularly tactical ballistic missile (TBM) launchers. ARPA's WAR BREAKER program will develop and demonstrate advanced technologies and systems to enable the detection, identification and prosecution of high value, time-critical fixed and mobile targets including TBM launchers, mobile command posts, tanks and artillery. This project serves as the framework for maturing and integrating advanced technologies developed within the Advanced Targeting Technology Project (TT-05) under PE 0602702E and developing and demonstrating system concepts supporting the prosecution of these targets. Key areas include advanced surveillance, target acquisition, automatic target detection and recognition, automated intelligence correlation, battlefield management, information distribution and terrain data generation technologies. This project is part of the ARPA contribution to the DoD Advanced Technology Demonstrations within the Global Surveillance and Communications and Precision Strike DDR&E thrust areas.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Designed passive, three-dimensional infrared sensor system and assessed its performance.
- (U) Continued development of high resolution, polarimetric synthetic aperture radar (SAR) for wide area search.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-40

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

- (U) Completed initial assessment of multi-mode, multispectral, passive/active electro-optic infrared (EO/IR) technology requirements for target discrimination.
- (U) Initiated foliage penetration (All Environment Sensor/FOPEN) radar technology development and phenomenology assessment.
- (U) Initiated analysis of utility and technical requirements for a 3-D interferometric synthetic aperture radar (IFSAR) to prosecution of critical mobile targets.
- (U) Initiated concept development and system studies for an integrated system for sensing, finding, localizing and destroying time-critical fixed and mobile targets (WAR BREAKER) using advanced distributed simulation tools.
- (U) Demonstrated the utility of 3-D IFSAR in support of automated digital terrain elevation (DTE) extraction.

(U) FY 1993 Planned Program:

- (U) Focus development of advanced Automatic Target Detection/Recognition algorithms for specific application to advanced SAR and Moving Target Indicator (MTI) radar for both wide area and focused surveillance.
- (U) Continue concept designs of integrated surveillance system employing advanced MTI/SAR radar and multispectral EO/IR sensor.
- (U) Continue FOPEN radar technology development.
- (U) Complete Thirsty Saber system and subsystem hardware fabrication.
- (U) Complete WAR BREAKER baseline concept development.
- (U) Continue WAR BREAKER systems studies incorporating initial distributed simulation system capability.
- (U) Begin design of Low-Cost Ultra-Wideband (UWB) radar for unmanned aerial vehicles (UAVs).
- (U) Continue IFSAR development.
- (U) Initiate Gamma-Gamma resonance imaging development.
- (U) Achieve terrain delimitation goal of providing reduced target search volumes with rapid turnaround.

(U) FY 1994 Planned Program:

- (U) Initiate tests on advanced Moving Target Indicator/Synthetic Aperature Radar (MTI/SAR) Automatic Target Detection/Recognition algorithms.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-40

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

- (U) Continue experiments designed to statistically validate advanced algorithms applicable to advanced target detection radars.
- (U) Conduct initial tests of 3-D digital terrain elevation (DTE) interferometric synthetic aperture radar (IFSAR).
- (U) Conduct Thirst Saber captive flight tests.
- (U) Complete baseline development of WAR BREAKER distributed simulation system.
- (U) Transition appropriate low-cost focal plane array technology to Multi-Spectral effort.
- (U) Begin development of Ultra-Wideband Foliage Penetration (All Environment Sensor/FOPEN) radar.
- (U) Continue development of components/systems which extract, correlate, fuse and display intelligence information to determine changes in force status, order of battle, and operational doctrine of time critical targets.
- (U) Initiate development of dynamic intelligence processor and tracking functions for the Local Attack Controller.
- (U) Demonstrate technology to rapidly fuse and distribute historical intelligence database information.
- (U) Initiate algorithm development for Multi-Spectral and IFSAR processing for feature extraction and elevation data fusion and for real-time modification of theater terrain data.

(U) Program to Completion:

- (U) Demonstrate advanced Automatic Target Detection/Recognition algorithms for MTI/SAR radars.
- (U) Complete fabrication and test advanced, low-medium, altitude target acquisition/prosecution system.
- (U) Demonstrate improved unattended ground sensors (UGS) and the potential for an internettted UGS system.
- (U) Complete Ultra-Wideband (UWB) foliage penetration (All Environment Sensor/FOPEN).
- (U) Demonstrate capability to correlate all-source intelligence for detection, tracking, targeting, and destruction of time critical targets.
- (U) Demonstrate integrated intelligence correlation and battle management to facilitate local attack control.
- (U) Demonstrate technology to build and distribute over a wide area network, terrain and feature and intelligence and object data for a 1 million square KM theater.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Project Number: EE-40
PE Title: Experimental Evaluation of Budget Activity: 2. Advanced
Major Innovative Technologies Technology Development
Date: April 1993

- (U) Demonstrate Multi-Spectral and IFSAR processing feature extraction and elevation data fusion and real-time modification of theater terrain data.

D. (U) WORK PERFORMED BY: General Dynamics/Convair Division, San Diego, CA; Martin-Marietta, Orlando, FL; ERIM, Ann Arbor, MI; Lincoln Laboratory, Lexington, MA; Texas Instruments, Dallas, TX; BDM International, McLean, VA; SAIC International, Arlington, VA; Sandia National Lab, Santa Fe, NM; Lockheed Missile Systems, Austin, TX; ADS/Booz Allen, Palo Alto, CA; Pacific Sierra Research, Santa Monica, CA; Atlantic Aerospace, Greenbelt, MD; Grumman Aerospace Corporation, Melbourne, FL; LOGICON, San Pedro, CA; and others to be determined.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: The FY93 increases are the result of Congressional adds in the areas of IFSAR and Gamma-Gamma Resonance imaging development.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: This effort builds directly upon and/or integrates with the following ongoing ARPA programs: Smart Weapons Application Program (EE-30); Advanced Targeting Technology (TT-05); Relocatable Targets (RT-01); and Advanced Simulation (EE-37). This project is a part of the ARPA contribution to the Joint DoD Advanced Technology Demonstration for Global Surveillance and Communication and Precision Strike Thrust Areas.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Feb 93	Complete WAR BREAKER baseline concept.
May 93	Demonstrate 3-D IFSAR in support of automated mapping.
May 93	Installation of Generic Monitoring System at USAREUR Joint Analysis Center.
Aug 93	Complete Thirsty Saber system/subsystem hardware fabrication.
Mar 94	Demonstrate capability to temporarily use intelligence information to track time critical targets (TCTs).
Mar 94	Complete Thirsty Saber captive flight tests.
Feb 95	Complete WAR BREAKER distributed simulation.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-40

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

Nov 95	Demonstrate automapping capability using IFSAR.
Nov 95	Initial demonstration of automatic cue development from contextual analysis of MTI Radar data (MTI ATR).
Nov 97	Demonstrate integrated intelligence correlation and battle management to facilitate local attack control.
Nov 97	Demonstrate technology to build and distribute over a wide area network, terrain and feature and intelligence and object data for a 1 million square KM theater.
May 98	Conduct integrated wide area/focused surveillance system demonstration.
Nov 98	Demonstrate capability to correlate all-source intelligence to detection, tracking, targeting, and destruction of time critical targets.
Sep 98	Demonstrate Multi-Spectral and IFSAR processing feature extraction and elevation data fusion and real-time modification of theater terrain data.
Jun 99	Conduct fully integrated WAR BREAKER demonstration.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-41

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title:

<u>Popular</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>FY 1994</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
EE-41	Air Defense Initiative (ADI)				
	(95,645)*	(32,018)*	27,717	Continuing	Continuing

*Formerly funded in OSD PE 0603741D.

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: ADI is a companion to the Strategic Defense Initiative (SDI) program. To ensure defenses against manned aircraft and cruise missiles are developed concurrently with defenses against ballistic missiles, the program approach entails vigorous concept exploration, with coordination among the Services and SDIO, and early involvement by the operational community. Technical developments in surveillance and identification, engagement, and battle management/C³ are incorporated into a series of projects to demonstrate key concepts. Individual ADI efforts under EE-41 are described below. Other ADI efforts are in the EE-CLS/ADI Project.

(U) The Mountaintop Program is to determine how current radar technology can be extended to meet more stressing airborne threat requirements. An existing radar developed by the Navy will be used as the primary sensor for Mountaintop testing. Mountaintop provides a cost effective approach, avoiding new hardware development, to evaluate new and innovative technologies, especially in signal processing. Mountaintop is a joint activity with the following principal radar technology development and demonstration subprojects: (1) Development of a phenomenology and propagation data base; (2) Development of advanced adaptive space-time processing architectures, hardware and algorithms required for future surveillance radars; and (3) Support of integrated architecture testing.

(U) The Airship program completes an earlier Navy program. Airship platforms have unique capabilities as an airborne sensor platform. Airship features for cruise missile and area defense include long flight endurance, payload volume, flight speed, and vibration characteristics. The design of the Operational Development Model (ODM) Airship program will continue through Critical Design Review (CDR) and testing. Demonstrations on the S-1000 Airship will be conducted.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-41

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

(U) The HAVE DUNGEON project continues funding of the Proof-of-Concept Aerospace Defense Location (PADL) in Colorado Springs. This facility allows for intense user/developer working relationships to demonstrate the value of ADI technology using a mixture of live and simulated data, plus advanced visualization techniques. By integrating National Sensor and other data sources, HAVE DUNGEON will continue to support the ADI program in the critical areas of wide-area surveillance and detection of cruise missiles and their carriers, with the goal of "birth-to-death" tracking of airborne threats.

(U) An improved modeling and simulation system will be created called Air Defense Initiative Simulated Technologies (ADIST). Its mission is to support the Services' transition of innovative air defense technologies, including efforts in the EE-CLS/ADI project. To that end, it will emphasize the cruise missile threat and its integration into ongoing service Theater Missile Defense activities. It will combine and develop software tools that aid in technology conception, design, test, and system visualization. It will build on the PADL software capabilities and link them with existing Service modeling and manned simulator facilities. It has these thrusts: ADI architecture trade-off studies with analytic models and interface with the Air Force Theater Air Command and Control Simulator Facility (TACCSF) and the Navy Weapons and Tactic Analyses Center (WEPTAC) for man-in-the-loop simulation exercises; development of sensor/platform models within a prototype distributed simulation environment; and extension of the prototype environment to interact with the ARPA WAR BREAKER Defense Distributed Simulation System.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Navy ADI-ASW efforts support timely detection of SLCM-carrying submarines in marginal waters. Projects included active and passive acoustics, signal processing, and architecture requirements. ASW sea tests conducted and analyzed in 1992 included E-1, CST-6, AIREM, and SHAREM.
- (U) The ADI Mountaintop program began planning and testing of hardware and test capabilities to provide cost-effective testing of advanced sensor concepts.
- (U) The HAVE DUNGEON program applied their user/developer simulation environment at PADL to demonstrate and test ADI technologies for tracking, fusion, identification, and C³.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-41

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

- (U) Under the Airship program, tasking to complete the ODM CDR was continued, and critical technology tests and demonstrations were planned.

(U) FY 1993 Planned Program:

- (U) The completion of the Airship program is planned. The CDR for ODM will be completed, and critical technology testing and demonstrations accomplished.
- (U) HAVE DUNGEON will address wide area surveillance capabilities, battle management, and cruise missile and carrier detection and identification.
- (U) For the Simulation program, ADIST actions will address requirements definition and allocation, prototype simulation development, architectural trade-off studies, and initial linkage of PADL and the AF Theater Command and Control Simulation Facility.

(U) FY 1994 Planned Program:

- (U) Mountaintop testing, data gathering and analysis will continue, including phenomenology and propagation measurements and siting of the UHF radar at PMRF Barking Sands, Kauai, Hawaii.
- (U) HAVE DUNGEON will adapt capabilities to address regional situations of interest.
- (U) Simulation will continue ADIST activities and begin linkage of geographically separate models and manned simulators within the ARPA WAR BREAKER Defense Distributed Simulation System.

(U) Program To Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: The organizations currently contracting and performing work on ADI include: SPAWAR, NCCOSC, and NUSC for Navy activities; AF Materiel Command: ESC, Rome Lab, and Aeronautical Systems Command; and Army SDC and Missile Command.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: ADI funding has been transferred to ARPA in FY 1994. Funds and programs that were formerly in OSD PE 0603741D now are described under the EE-41 and EE-CLS/ADI projects. ASW responsibility and funding was transferred to the Navy in FY 1993. Completion of the Airship program with FY 1993 funding is planned.

F. (U) PROGRAM DOCUMENTATION: ADI Program Plan, February 1991.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-41

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

G. (U) RELATED ACTIVITIES: The ADI program is coordinated with other technology efforts and plans for tactical and strategic air defense. Applicable related program elements include: SDIO PEs developing theater, national, and global ballistic missile defenses and Advanced ASW Technology Programs. ADI activities are integrated with a number of related ARPA efforts.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestone</u>
	Mountaintop Project:
Jan 94 -	Initiate CNavY ADS-18S antenna/radar testing at White Sands Missile Range (WSMR).
Mar 94 -	Complete land clutter experiments at WSMR.
Jun 94 -	Initiate operational experiments at Pacific Missile Range Facility with RSTER Antenna/Radar.
	Simulation Project:
Jan 94 -	Complete ADIST integration with PADL.
Mar 94 -	Begin analytic studies with ADIST prototype simulation system on advanced sensor and architecture concepts.
Jul 94 -	Complete platform/sensor model development efforts and integrate into simulation.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-45

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Global Grid Communications

<u>Popular</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>FY 1994</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
EE-45	Global Grid Communications				
	0	0	20,881	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: This program develops and demonstrates advanced communications technologies needed for defense and intelligence operations for the 21st century. The program will demonstrate that commercial communications resources and technologies can be integrated with advanced optical components developed in this program as well as DoD tactical and satellite technology developed elsewhere. Interoperability between diverse networks such as existing commercial, optical and secure wireless will be demonstrated. Key elements are:

(U) Research and development of optical components that will permit the DoD to substantially reduce the number of fibers, switches, and repeaters required for deployment of gigabit network capability. Electronic content will be reduced so that the cost of electronic upgrades is minimized.

(U) Research and development of network control, management, and security software technologies to enable sensor-to shooter applications combining all network media.

(U) Demonstration networks that validate the R&D and enable early application development and technology transition into DoD efforts such as Defense Information System Networks.

(U) Advanced services, such as scalable file systems, databases, and distributed computing support that are integrated with high performance computing, and free applications from the necessity to work down to the raw data transport level.

(U) Applications, including intelligent decision aids, that enable a geographically distributed planning staff to develop and analyze a course of action within 4 hours.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-45

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments: N/A (New FY94 start)

(U) FY 1993 Planned Program: N/A (New FY94 start)

(U) FY 1994 Planned Program:

- (U) Optical component development.
- (U) Software architecture for joint task force planning/execution including weather, intelligence, strike planning, and logistics.
- (U) Demonstrate interoperability between commercial and DoD network assets.
- (U) Initiate network management, control, signalling efforts.

(U) Program to Completion:

- (U) Integrate DoD and commercial networks with military attributes such as crypto, surge capability.
- (U) Demonstrate advanced optical network capability.
- (U) Demonstrate integration on a CONUS scale using all networks.
- (U) Demonstrations of planning exercises.

D. (U) WORK PERFORMED BY: Competitive award of contracts. Major performers will include telecommunications, electronic and computing companies.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: N/A (New FY94 start)

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: The program is coordinated with: The national High Performance Computing and Communication Program (that will provide theory and limited-area experience), the ARPA consortia on all-optical network and optoelectronic components, the component crypto development by NSA, and the JDL C3 and Computer Science panels. This program will produce the system technologies required by Global Surveillance and Communication thrust area activities.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-45

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Planned</u>	<u>Milestone</u>
Apr 95	Demonstrate optical component prototypes.
Jul 95	Multiple crisis scenario (integrated simulation and modelling tools, more powerful trade-off analysis).
Oct 95	Integrate defense high performance networks with cross country backbone using SONET/ATM. Early planning support demonstrations.
May 96	Demonstrate network combining crypto, commercial communications, and defense secure wireless, satellite.
May 97	Demonstrate integration with advanced optical testbeds. Large scale planning demonstrations.
Jul 97	Deployable JTF C3 (mobile C3, plan rehearsal and refinement during deployment, intelligent interfaces).
May 98	Cross-country demonstration of optical and advanced network management.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603569E

PE Title: Advanced Submarine Technology

Project Number: AS-01

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Advanced Submarine Technology (SUBTECH)

<u>Popular</u> <u>Name</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
AS-01	SUBTECH 71,458	52,049	32,556	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: The objectives of this project are to develop and demonstrate advanced concepts and to pursue critical enabling technologies for future ship classes. The evolving worldwide threat of quiet diesel submarines and the proliferation of sophisticated submarine and weapons capabilities available to third world countries necessitate a continued superior U.S. submarine force. U.S. submarine technologies must keep pace with the changing threats and remain immune to technological surprises. The main thrust of this project is to provide, in the specific areas of active structural vibration control and advanced materials, far-term solutions to ship affordability and capability in this new operational environment.

(U) This project brings to fruition the development of structural technologies under the Active Impedance Modification (AIM) and Advanced Vibration Reducer (AVR) efforts to reduce submarine observables. These technologies will significantly enhance submarine stealth and survivability. They form the basis for efforts addressing affordability of ultra-high precision machinery used for submarine noise-critical applications and high reliability propulsion systems. Advanced thick section composites and embedded sensors efforts are demonstrating the advanced structural fabrication processes and strength monitoring capabilities necessary to introduce affordable advanced lightweight structural materials into submarine construction programs.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Transitioned Enhanced Surface Tube Condenser, Submarine Advanced Integrated Life Support System, Silver Zinc Battery, Axial Flow Shaftless Pump, Advanced Turbine Generator Seals, Electromagnetic Signature Reduction, Project I, Project S, Intermediate Scale Measurement System (ISMS), and Submarine Compute-Off (SUBOFF) projects to the Navy.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603569E

Project Number: AS-01

PE Title: Advanced Submarine Technology

Budget Activity: 2. Advanced

Technology Development

Date: April 1993

- (U) Demonstrated Low Frequency Active (LFA) target strength reduction at 30:1 scale model.
 - (U) Completed Magnetohydrodynamic (MHD) large-scale thruster experiment.
 - (U) Completed Proton Exchange Membrane (PEM) fuel cell subsystem demonstrations.
 - (U) Completed shaftless pump acoustic and performance testing.
 - (U) Completed land and sea tests of Non-Penetrating Periscope.
 - (U) Conducted Radio Control Model (RCM) free running hydrodynamic maneuvering tests.
 - (U) Commenced Active Impedance Modification (AIM) algorithm development and completed development of a specialized digital signal processor; fabricated Active Impedance Modification (AIM) prototype transflexural elements.
 - (U) Completed site preparation for Advanced Vibration Reducer (AVR) Full Scale Land Based tests.
 - (U) Completed stable magnetic levitation demonstration of machinery raft model.
 - (U) Commenced design of Stealth Designer's Workbench (SDW).
 - (U) Completed SUPRELITE quarter-scale water tests.
- (U) FY 1993 Planned Program:
- (U) Complete corrosion studies to predict calendar life of the roll-bonded nickel electrode of the nickel-cadmium (Ni-Cd) battery.
 - (U) Demonstrate benefit of Metal Oxide Semiconductor (MOS) Controlled Thyristor (MCT) and Auxiliary Resonant Commutated Pole in an adjustable speed 200 horsepower motor drive.
 - (U) Commence testing of Active Impedance Modification (AIM) prototypes; complete development of AIM algorithms.
 - (U) Fabricate Advanced Vibration Reducer (AVR) Components; transition to Navy.
 - (U) Investigate techniques for affordable high precision fabrication of noise-critical machinery components.
 - (U) Develop and optimize mid-frequency structural acoustics code for Stealth Designer's Workbench (SDW); develop Dimensional Adaptive Mesh Generator for SDW.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603569E

PE Title: Advanced Submarine Technology

Project Number: AS-01

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

- (U) Determine feasibility of active turbulence control.
- (U) Transition Submarine Hydrodynamic/Hydroacoustic Technology Center (SH/HTC) to Navy.
- (U) Develop structured modeling techniques required to analyze innovative ship construction and noise isolation technologies.

(U) FY 1994 Planned Program:

- (U) Fabricate non-autoclave cure thermoplastic-stiffened composite cylinders (4-foot diameter); begin testing thermoset sphere (4-foot diameter).
- (U) Complete fabrication of SUPRELITE components; complete SUPRELITE first-year fatigue test; install SUPRELITE on submarine and conduct at-sea testing.
- (U) Commence array testing of Active Impedance Modification (AIM).
- (U) Integrate vector and parallel processors for Stealth Designer's Workbench (SDW).
- (U) Demonstrate feasibility of affordable high precision machining operations for fabrication of noise-critical machinery components.
- (U) Investigate techniques for active suppression of vibration and noise in turbines.
- (U) Analyze and optimize selected innovative ship construction and noise isolation techniques.

(U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: AT&T Bell Laboratories, Whippany, NJ; GEC-Marconi, United Kingdom; Pennsylvania State University/Applied Research Laboratory, State College, PA; McDonnell Douglas Aircraft, St. Louis, MO; General Dynamics/Electric Boat Division, Groton, CT; Grumman Aerospace, Bethpage, NY.; and Lockheed Missiles and Space, Palo Alto, CA.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: This program is a continuation of the Congressionally-mandated Submarine Technology Program (STP).

F. (U) PROGRAM DOCUMENTATION: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603569E

PE Title: Advanced Submarine Technology

Project Number: AS-01

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

G. (U) RELATED ACTIVITIES: This program has been coordinated with the Program Executive Officer, Submarines (PEO-SUB-R) to ensure there is no duplication of effort and that developed technologies are properly transitioned to the Navy.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Apr 93	(U) Commence testing of Active Impedance Modification (AIM) prototypes.
Nov 93	(U) Complete initial SUPRELITE fatigue tests.
Jan 94	(U) Complete fabrication of full scale propulsor rotor.
Feb 94	(U) Perform initial testing of thick section composites 4-foot thermoset sphere structures.
May 94	(U) Commence Active Impedance Modification (AIM) array testing.
Jul 94	(U) Conduct demonstration of high precision machine operations for noise critical machinery.
Dec 94	(U) Conduct initial Stealth Designer's Workbench (SDW) validation tests.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603570E
PE Title: Defense Reinvestment

Budget Activity: 2. Advanced
Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Defense Reinvestment

<u>Popular</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>FY 1994</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
Defense Reinvestment	60,000	561,633	349,000*	N/A	Continuing

*Includes \$25.0 million of FY 1993 Title VIII funds that will be applied to FY 1994 Manufacturing Extension and Dual-Use Assistance Extension Programs.

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: The purpose of this program is to invest in activities to stimulate development of technologies that have dual-use application that can enable new military capabilities as well as have potential for enabling new commercial products and lead to an integration of commercial and military production and processes. As a result, technologies will be developed and deployed to increase both national security and the national economy. This will be accomplished through the application of defense and commercial resources to develop dual-use technologies, manufacturing and technology assistance to small firms, and education and training programs that enhance U.S. manufacturing skills and target displaced defense industry workers. The program consists of multiple programs.

(U) **Defense Dual-Use Critical Technology Partnerships** -- supports partnerships aimed at developing technologies that have both military and commercial applications.

(U) **Commercial-Military Integration Partnerships** -- supports partnerships aimed at developing and maturing dual-use technologies with clear commercial viability.

(U) **Defense Advanced Manufacturing Technology Partnerships** -- funds partnerships aimed at developing new manufacturing technologies with dual-use applications.

(U) **Manufacturing Engineering Education Grant Program**-- supports manufacturing engineering education programs at colleges, universities and other institutions of higher education on a matching basis.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603570E
PE Title: Defense Reinvestment

Budget Activity: 2. Advanced
Technology Development
Date: April 1993

(U) **Manufacturing Extension Program** -- assists small manufacturers (with up to 500 employees) in upgrading their capabilities to serve commercial and defense needs.

(U) **Defense Dual-Use Assistance Extension Program** -- assists businesses economically dependent on Department of Defense expenditures to acquire dual-use capabilities through a variety of mechanisms.

(U) **Regional Technology Alliances Assistance Program** -- supports the development and maturing of dual-use technologies in one or more focused geographical regions of the U.S., implemented through eligible regional technology alliances.

(U) **Agile Manufacturing/Enterprise Integration Program** -- is designed to capitalize on the emerging shift from mass production to flexible "agile" manufacturing. Enterprise Integration allows independently-owned companies to form instantaneous partnerships with firms that have complementary capabilities in order to exploit market opportunities.

(U) **Advanced Materials Synthesis and Processing Partnerships** -- supports partnerships aimed at improving industry's ability to take new materials from the laboratory to commercial production.

(U) **U.S.-Japan Management Training Program** -- provides training for U.S. scientists, engineers and managers in Japanese technology management, language and culture, and provides research opportunities in Japan.

(U) The program will be executed primarily based on a formal solicitation in May 1993, with proposals due in July. The proposals will be reviewed in an inter-agency selection process with award of contracts, grants and agreements planned for September 1993. Allocation of the FY 1994 funds by individual program category will be made based on the response to the solicitation and FY 1993 awards.

(U) The FY 1994 program includes the entire ARPA Small Business Innovation Research (SBIR) Program of \$28.0 million that will be applied to focused dual-use programs.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603570E
PE Title: Defense Reinvestment

Budget Activity: 2. Advanced
Technology Development
Date: April 1993

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Developed pre-competitive technology consortia in areas of precision investment casting, optical networks, data storage, micromagnetic components, ultra-dense capacitor materials, and electromagnetic codes.

(U) FY 1993 Planned Program:

- (U) Hold regional meetings throughout the U.S. to brief interested organizations and individuals on defense reinvestment participation.
- (U) Publish solicitation for proposed partnerships.
- (U) Select and award new partnership agreements.

(U) FY 1994 Planned Program:

- (U) Execute FY 1994 increments of ongoing FY 1993 programs and establish new partnerships.

(U) Program to Completion: Not applicable.

D. (U) WORK PERFORMED BY: Partnerships are composed of industry, federal laboratories, institutions of higher education, state government agencies, Government-owned and operated industrial facilities, and other entities that support the activities of the firms or non-profit research corporations.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: Not applicable

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: Ongoing government research projects.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Budget Activity: 2. Advanced

PE Title: Electronics Manufacturing
Technology

Technology Development

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
MT-01	Microelectronics Manufacturing 98,000	0	0	Continuing	Transferred to PE 0603745E
MT-02	Microwave/Millimeter Wave Monolithic 85,528	80,179	80,181	37,552	596,209
MT-03	IR Focal Plane Array (IRFPA) 17,404	34,150	41,429	Continuing	Continuing
MT-04	Electronic Module Technology 5,129	67,258	97,080	Continuing	Continuing
MT-05	Tactical Display Systems 0	10,078	9,467	Continuing	Continuing
MT-07	Centers of Excellence 0	27,665	4,837	Continuing	Continuing
MT-08	Manufacturing Technology Initiatives 0	0	19,146	Continuing	Continuing
MT-10*	Advanced Lithography 0	0	47,457	Continuing	Continuing
TOTAL	206,061	219,330	299,597		

*Previously funded in PE 0602712E, Project MPT-04.

B. (U) BRIEF DESCRIPTION OF ELEMENT: The Electronics Manufacturing Technology program element focuses on seven specific projects to develop and enhance various microelectronics systems. The programs contained in Projects MT-02, MT-03, MT-04, MT-08 and MT-10 reflect the Department's initiative to support dual-use technologies.

(U) Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) works to accelerate the development, manufacturing and demonstration of affordable microwave and millimeter wave analog integrated circuits.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Budget Activity: 2. Advanced

PE Title: Electronics Manufacturing
Technology

Technology Development

Date: April 1993

(U) The IR Focal Plane Array project focuses on the establishment of a manufacturing base for advanced infrared sensor arrays for major weapons systems. This base will allow the systems to meet operating requirements at approximately 1% of the current cost.

(U) Electronic Module Technology's goal is to allow for the timely insertion and rapid acquisition of three components into major military systems. These systems include automatic target recognition, electronic countermeasures and Signal Intelligence (SIGINT). The three components are state-of-the-art microensors and actuators, conformal electronics and affordable, high performance application specific electronic modules (ASEM).

(U) Tactical Display Systems develops and demonstrates high definition miniature displays to provide visual information to troops who are remotely located from conventional visual information sources.

(U) Centers of Excellence focus on the demonstration, deployment of and training on advanced manufacturing technologies. The goal of this technology is to reduce unit and life cycle costs while improving quality.

(U) Manufacturing Technology Initiatives advance the capability of the U.S. industrial base to respond rapidly and flexibly to both military and commercial demands.

(U) Advanced Lithography seeks to advance the current microelectronics manufacturing capabilities using advanced lithography technology.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E Project Number: MT-02
PE Title: Electronics Manufacturing Budget Activity: 2. Advanced Technology
Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Microwave/Millimeter Wave Monolithic Integrated Circuits

<u>Popular</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>FY 1994</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
MT-02	MIMIC				
	85,528	80,179	80,181	37,552	596,209

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: This project provides for the acceleration of development, manufacturing and demonstration of affordable microwave and millimeter wave analog integrated circuits (ICs). The Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) program is providing previously unavailable microwave and millimeter-wave integrated circuits to enable DoD systems to meet size, weight and power constraints at the lowest possible cost. Its primary thrust is to develop affordable circuits operating in the 1 to 100 GHz frequency range with required characteristics and in sufficient quantity to satisfy military systems needs. The use of reliable and maintainable semiconductor devices and circuits for selected system demonstrations will be accelerated and, thus provide the United States with a technological lead in deploying MIMIC-based military systems.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Continued enhancement of capabilities to produce devices, circuits and subsystems with needed characteristics for DoD systems.
- (U) Continued integration of Computer Aided Design (CAD) capabilities with manufacturing lines and on-line test capabilities.
- (U) Began transfer of advanced materials, devices, design software, packaging and testing technologies into MIMIC fabrication lines.
- (U) Integrated Multi-function Self-Aligned Gate (MSAG) Technology into military radar systems.
- (U) Continued work on Microwave Hardware Description Language (MHDL).
- (U) Initiated technology support programs in the following areas: materials, fabrication processes, computer aided design, testing, integration and packaging, and innovative circuit technologies.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-02

PE Title: Electronics Manufacturing
Technology

Budget Activity: 2. Advanced Technology
Development

Date: April 1993

(U) FY 1993 Planned Program:

- (U) Deliver first multi-function MIMICs meeting required system specifications.
- (U) Begin assembly of advanced MIMIC modules and system brassboards.
- (U) Continue development of advanced materials, devices, design software, packaging and testing technologies.

(U) FY 1994 Planned Program:

- (U) Continue work on Microwave Hardware Description Language.
- (U) Complete delivery of process demonstration wafers.
- (U) Complete fabrication of MIMIC Phase 2 chips.
- (U) Begin assembly of MIMIC modules and brassboards.
- (U) Begin to make available to all DoD system contractors the MIMIC pilot lines, CAD and test facilities.

(U) Program to Completion:

- (U) Continue work on Microwave Hardware Description Language.
- (U) Deliver MIMIC chips, modules and brassboards.
- (U) Conduct advanced demonstrations of cost reductions and expanded system applications.
- (U) Reach cost goal of \$.80/mm² for MIMIC gallium arsenide chips.
- (U) Make available to all DoD system contractors the MIMIC pilot lines, CAD and test facilities.
- (U) Make available second sources of supply for MIMIC chips.
- (U) Program completes in FY 1995.

D. (U) WORK PERFORMED BY: In-house work will be performed by: Army Research Laboratory; Naval Air Systems Command; U.S. Naval Research Laboratory; Air Force Wright Laboratory, and Rome Laboratory. Hardware development phase prime contractors are: Hughes Aircraft Company, El Segundo, CA; General Electric, Syracuse, NY; Martin-Marietta, Orlando, FL; ITT, Roanoke, VA; Raytheon Co., Bedford, MA; Texas Instruments, Dallas, TX; and TRW, Redondo Beach, CA.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: Consistent with the FY 1993 Descriptive Summary.

F. (U) PROGRAM DOCUMENTATION:

- (U) Managements Structure for the Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) Program, 9/85.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-02

PE Title: Electronics Manufacturing
Technology

Budget Activity: 2. Advanced Technology
Development

Date: April 1993

- (U) Program Plan for MIMIC, 5/86.
- (U) Acquisition Plan No. DoD 86-X for MIMIC Program, 10/86.

G. (U) RELATED ACTIVITIES: Exploratory and advanced development of gallium arsenide monolithic components are being undertaken within Army, Navy, and Air Force RDT&E program elements.

(U) The work performed under this project within Program Element #0603739E is complementary to the work performed in the above service program elements. There is no duplication of effort within the Department of Defense.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Jun 94	Complete fabrication of MIMIC chips.
Jan 95	Deliver MIMIC Phase 2 chips, modules and brassboards.
Jan 95	Complete integrated design/fabrication/test capabilities at MIMIC Phase 2 contractors.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
PE Title: Electronics Manufacturing
Technology

Project Number: MT-03
Budget Activity: 2. Advanced
Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: IR Focal Plane Array

<u>Popular</u> <u>Name</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>To</u> <u>Program</u>
IRFPA	17,404	34,150	41,429	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: The Infrared Focal Plane Array (IRFPA) project establishes a manufacturing base for advanced infrared (IR) sensor arrays required for major weapon systems. Improvements in infrared materials, detector array fabrication, read-out electronics, cryogenic testing and module assembly are addressed in order to provide affordable infrared sensors to system developers. Systems requiring affordable tactical infrared focal plane arrays include missile seekers, airborne and ground-based target acquisition systems, and infrared search and track systems. Currently, the IRFPAs are produced at low rates and high cost with technology that is just emerging from the laboratory environment. The goal of this project is to produce IRFPAs that meet system requirements with a hundred-fold cost reduction relative to the cost at the beginning of the project.

(U) The project initially focused on sensors with response in the 8-to-10 micron infrared spectral region for use in tactical systems. The cost of these arrays is being reduced through the development of large-area, uniform material wafers, improved repeatability of 8-to-10 micron detector processes, increased functionality of the read-out integrated circuit; and automation of cryogenic test procedures. Integration of these advancements into manufacturing lines producing IRFPAs in weapon system configurations is providing affordable tactical IRFPAs in the quantities necessary to meet defense system needs.

(U) Beginning in FY 1993, the IRFPA project was expanded to include scalable infrared focal plane array manufacturing to meet the full spectrum of defense needs. Additional systems addressed by this program will include high-performance missile seekers, space surveillance systems, threat warning systems, and large-area staring arrays for improved ground and air-based target acquisition. In the future, smart weapons will employ infrared focal plane arrays for autonomous target

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing
Technology

Project Number: MT-03

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

acquisition and identification. Because the production volume of any specific IRFPA is very low, the only way to ensure affordable IRFPAs for DoD is through the establishment of highly flexible, scalable manufacturing capability. The lines will have the flexibility to scale up to higher rates to meet production requirements. This project reflects the OSD Advanced Technology Demonstration for scalable IRFPA manufacturing and supports the Technology for Affordability DDR&E thrust area.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Implemented improved material screening for the growth of infrared material on silicon substrates, resulting in the imaging demonstration of a high quality 480x4 IRFPA.
- (U) Demonstrated the feasibility of in-process sensors to control liquid phase epitaxial material growth and used improved material to fabricate 240x1 IRFPAs.
- (U) Fabricated, using the dry etching process, a 64x64 IRFPA meeting missile seeker specifications.

(U) FY 1993 Planned Program:

- (U) Demonstrate vapor phase growth on silicon substrates to produce large-area long-wavelength staring arrays.
- (U) Demonstrate improved screening of IR material; x2 increase in the arrays passing wafer-level evaluation.
- (U) Manufacture a large scanning IRFPA with improved reliability (greater than 1,000 thermal cycles without failure).
- (U) Implement manufacturing technology using a two-inch substrate, which contains more than 60 64x64 IRFPAs.
- (U) Implement improved control over infrared material growth process as initial demonstration of flexibility in IRFPA manufacturing.
- (U) Initiate activity for a physical model describing defects in IR material as the initial step toward flexible IRFPA manufacturing.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
PE Title: Electronics Manufacturing
Technology

Project Number: MT-03
Budget Activity: 2. Advanced
Technology Development
Date: April 1993

(U) FY 1994 Planned Program:

- (U) Demonstrate improved wafer morphology to reduce defect density in long-wavelength staring arrays.
- (U) Complete physical model describing IR detector surface leakage mechanism.
- (U) Fabricate modules for tactical applications.
- (U) Complete read-out circuit design and fabricate read-out common to mid- and long-wavelength devices.
- (U) Demonstrate long wavelength scanning arrays with cut-off of 11.0 microns at 77°K.

(U) Program to Completion:

- (U) Demonstrate large-area 480x640 mercury cadmium telluride IRFPAs on a silicon substrate.
- (U) Demonstrate manufacturing technology for 64x64 staring arrays with greater than 90% operability at a cost of less than \$2,000 per IRFPA.
- (U) Demonstrate 128x128 IRFPAs on a silicon substrate for greater ease of material handling and compatibility with commercial manufacturing equipment.
- (U) Demonstrate IRFPA manufacturing with 4-inch wafers.
- (U) Complete the development of an integrated manufacturing capability for large-area (4-inch wafers) infrared semiconductors demonstrating a 100 times cost reduction for both staring and scanning arrays.
- (U) Demonstrate flexible, modular IRFPA manufacturing with the capability to rapidly reconfigure the line to produce 3-5 and 8-12 micron arrays for tactical and space surveillance applications.

D. (U) WORK PERFORMED BY: Contractors include: Santa Barbara Research Center, Santa Barbara, CA; Loral Infrared and Imaging Systems, Lexington, MA; Rockwell, Anaheim, CA; and Texas Instruments, Dallas, TX.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: Consistent with the Amended FY 1992/1993 Descriptive Summary.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: 40603739E
PE Title: Electronics Manufacturing
Technology

Project Number: MT-03
Budget Activity: 2. Advanced
Technology Development
Date: April 1993

G. (U) RELATED ACTIVITIES: Development of Infrared Focal Plane Array (IRFPA) technology and devices is being undertaken under Army, Navy, Air Force and Advanced Research Projects Agency (ARPA) program elements.

The related Service program elements are:

- (U) PE 0602709A, Night Vision Technology.
- (U) PE 0603774A, Night Vision System Advanced Development.
- (U) PE 0602234N, Systems Support Technology.
- (U) PE 0602204F, Aerospace Avionics.

The project supports development of flexible IRFPA manufacturing, capable of meeting tri-Service requirements. All Service and ARPA efforts are closely coordinated to assure that there is no duplication of effort.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Planned</u>	<u>Milestone</u>
Jun 93	Complete fabrication of long-wavelength infrared focal plane arrays of various configurations ranging from 240x1 to 480x640.
Sep 93	Demonstrate feasibility of process module for infrared focal plane array manufacturing.
Aug 94	Demonstrate a x100 cost reduction in the manufacture of two-dimensional, staring IRFPAs.
Aug 94	Assemble scalable focal plane array facility.
Sep 95	Demonstrate process module concept for multi-purpose scanning arrays.
Sep 95	Demonstrate equipment with flexibility to produce various IRFPA configurations on the same line.
Sep 96	Demonstrate large-area staring and scanning array for search and track, target acquisition, and missile seeker systems.
Sep 96	Demonstrate high-yield IRFPA manufacturing facility capable of varying production rates from small lots to high throughput rates.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E Project Number: MT-04
PE Title: Electronics Manufacturing Budget Activity: 2. Advanced
Technology Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Electronic Module Technology

Popular	FY 1992	FY 1993	FY 1994	To	To
Name	Actual	Estimate	Estimate	Complete	Program
Electronic Module Technology					
	5,129	67,258	97,080	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: The Electronic Module Technology Project is a broad initiative to substantially decrease the cost while increasing the performance of weapon systems through the timely insertion of state-of-the-art electronic modules. Electronic module technology addresses the interconnection and physical packaging of various types of digital and analog integrated circuits, as well as other electronic, electrooptical, and micro-mechanical components. It includes traditional approaches such as printed circuit boards, emerging technologies such as high density multi-chip modules (MCMs), and revolutionary approaches such as "conformal electronics".

(U) The project has four major objectives: 1) shorten the overall design, manufacture, test, and insertion cycle for advanced electronic subsystems; 2) advance the state-of-the-art in electronic interconnection and physical packaging technology to allow circuits to operate close to their intrinsic maximum speed with less overhead in terms of volume, weight and cost; 3) provide a robust manufacturing infrastructure for electronic modules; and 4) demonstrate the system level payoff of electronic module technology through advanced technology demonstrators (ATDs) such as the Rapid Prototyping of Application Specific Signal Processor (RASSP).

(U) The RASSP program is a major DARPA/tri-Service initiative directed toward dramatic reduction in the "time to fielding" of advanced signal processing capability. The signal processors to be developed will be used in DoD systems such as those for automatic target acquisition, tracking and recognition, electronic countermeasures, communications and Signal Intelligence (SIGINT). This overall project is integral to the Department's Science and Technology Thrust initiative in Technology for Affordability.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-04

PE Title: Electronics Manufacturing
Technology

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Initiated program to establish viable merchant infrastructure for Application Specific Electronic Modules (ASEMs).
- (U) Developed materials and processes for increased clock rate electronic multi-chip modules (MCMs).
- (U) Identified demonstration and insertion opportunities for advanced electronic modules.
- (U) Identified system applications for Rapid Prototyping of Application Specific Signal Processor (RASSP) program advanced technology demonstrator.

(U) FY 1993 Planned Program:

- (U) Develop a manufacturing line for MCMs capable of delivering a custom module in three months from the start date.
- (U) Demonstrate high yield production of 100-200 MHz MCMs.
- (U) Develop specifications for large area manufacturing equipment to support volume production of MCMs and flat panel displays.
- (U) Initiate efforts to integrate advanced optoelectronic devices into electronic modules.
- (U) Develop conformal printing and three-dimensional machine technologies for the manufacture of miniature electro-mechanical devices.
- (U) Commence work on RAASP including advanced computer aided design tools, extensions to hardware description languages, signal processor algorithm and architecture research, and manufacturing related efforts.

(U) FY 1994 Planned Program:

- (U) Demonstrate the ability to electronically transmit MCMs designs to multiple commercial foundries and receive completed modules in less than two months.
- (U) Develop a manufacturing pilot line capable of fabricating MCMs with 300 MHz performance and mixed digital technologies.
- (U) Demonstrate the technology to perform functional test of unpackaged die at their inherent speed of operation and

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-04

PE Title: Electronics Manufacturing
Technology

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

also to demonstrate a built-in-self-test capability at the module level.

- (U) Insert high-performance MCMs with operating frequencies of 100-200 MHz in existing weapons systems.
- (U) Develop threshold sensors for wide-area, unattended surveillance applications in threat monitoring and border-control.
- (U) Continue research and development activities on signal processing architectures, methodologies, design environment development, process benchmarking and business planning. Demonstrate first advanced signal processing circuits developed using RASSP methodology. Demonstrate first versions of improved architecture strategies, algorithms, computer aided design tools and frameworks.
- (U) Establish capability to provide information, seminars, and applications assistance to promulgate RASSP capabilities.

(U) Program To Completion:

- (U) Demonstrate foundry capability for flexible production of modules with board-level integration.
- (U) Develop and demonstrate capabilities to remanufacture electronic modules from a choice of multiple technologies.
- (U) Demonstrate volume manufacturing of electronic modules for weapon system upgrades and insertions.
- (U) Demonstrate the capability to cost-effectively produce modules that integrate sensors, computational processors, memories, high-bandwidth communication circuits, signal processors, control circuits, and microactuators.
- (U) Extend the electronic module computer-integrated manufacturing system and process control architecture to encompass upstream and downstream technologies.
- (U) Complete and demonstrate comprehensive signal processing design environment.
- (U) Demonstrate advanced signal processor applications to several DoD systems clearly establishing advantages of RASSP approach for improving performance and reducing overall cost.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E Project Number: MT-04
PE Title: Electronics Manufacturing Technology Budget Activity: 2 Advanced Technology Development
Date: April 1993

- (U) Provide an established knowledge base of RASSP methodology and capabilities for continuing use.

D. (U) WORK PERFORMED BY: Major contractors include: The Mayo Foundation, Rochester MN; Massachusetts Institute of Technology, Cambridge, MA; E-Systems, Garland, TX; Texas Instruments, Dallas, TX; David Sarnoff Research Center, Princeton, NJ; Carnegie Mellon University, Pittsburgh, PA; and Westinghouse Corporation, Pittsburgh, PA. In-house work, including management and support of contractual efforts, will be performed by: Advanced Research Projects Agency (ARPA); Army Laboratory Command Electronics Technology and Devices Laboratory; Office of Naval Technology; and Department of the Air Force, Wright Laboratories.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: ARPA added programs in conformal electronics, microsensors and actuators, and application-specific signal processing in FY 1993 and 1994.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: Effort is closely coordinated with ST-19, High Performance Computing and Communications (HPCC), MT-05, Tactical Display Systems, and IC-03, High Definition Systems (HDS) and programs that will provide vehicles for demonstrating the new technologies.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestone</u>
Dec 93	High yield, 100-200 MHz MCM demonstrations.
Jun 93	Demonstrate manufacturability of microactuator.
Sep 93	System Insertion Plan for 100-200 MHz MCM.
Sep 93	Demonstrate manufacturability of conformal electronics packaging technology.
Mar 94	0.25-2 GHz MCM demonstrations.
Oct 95	Achieve MCM capability of non-recurring engineering time of 3-6 weeks and cost of \$25,000.
Jul 96	Achieve Standard Electronic Module (SEM-E) Board capability.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E Project Number: MT-05
PE Title: Electronics Manufacturing Budget Activity: 2. Advanced
Technology Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Tactical Display Systems

<u>Popular</u>	<u>FY 1992</u>	<u>FY 1993</u>	<u>FY 1994</u>	<u>To</u>	<u>Total</u>
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
Tactical Display Systems	0	10,078	9,467	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: This project is based upon the need to maintain our information technology superiority in the command and control battlefield infrastructure. Visual information provides a better understanding of tactical situations and aids in making critical decisions in time constrained environments. The demand for accurate and timely visual information will increase in the future and will be required at all levels in the command structure. The objective of this project is to provide visual information to troops who are remotely located from conventional visual information sources i.e., computer terminals, televisions, etc. This project focuses on the development and demonstration of miniature displays that can be mounted close to the eye and provide information in the form of text, graphics, and still or moving pictures. Intended users are fixed and rotary wing pilots, combat vehicle crews, and dismounted warriors. The initial effort supports an Army Combat Vehicle Crew Helmet.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Initiated miniature display development.
- (U) Initiated project to integrate displays in a prototype helmet.

(U) FY 1993 Planned Program:

- (U) Complete development of 1280x1024 monochrome electroluminescent, and color liquid crystal miniature displays.
- (U) Continue Low Temperature Display Technology, including transient thermal processing, phosphors, and thin film IC's, and for system integration.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-05

PE Title: Electronics Manufacturing
Technology

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

- (U) Complete development of 640x512 color electroluminescent miniature display.
- (U) Initiate development of high efficiency backlight and color notch filters for liquid crystal displays.

(U) FY 1994 Planned Program:

- (U) Complete development of Army prototype Combat Vehicle Crew (CVC) helmet.
- (U) Initiate development of high resolution "eye-glass like" display devices and wide field of view displays.
- (U) Integrate voice input with helmet mounted displays.

(U) Program To Completion:

- (U) Complete prototype development of "eye-glass like" display devices.
- (U) Demonstrate wide field of view optical system.
- (U) Integrate head, hand, eye tracking devices into Army CVC helmet.
- (U) Demonstrate personal information presentation system.
- (U) Integrate personal information presentation system in operational warrior command and control system.

D. (U) WORK PERFORMED BY: The major performers are: Kopin Corporation, Taunton, MA; David Sarnoff Research Laboratory, Princeton, NJ; Planar Systems, Inc., Beaverton, OR; Standish Industries, Inc., Lake Mills, WI; Honeywell Inc., Phoenix, AZ; and Honeywell Inc., Bloomington, MN.

(U) Service support is provided by the U.S. Army Electronics Devices and Technology Laboratory, Ft. Monmouth, NJ; and the U.S. Army Natick Research, Development and Engineering Center, Natick, MA.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: Prior year funding for High Definition Systems is in PE 0602708E, Project IC-03.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: Coordination is accomplished through the Joint Service Working Group on Head Mounted Displays with membership from ARPA, Army, Navy, Air Force and NASA. This project is coordinated with the following military programs: The Integrated Enhanced Soldier

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E Project Number: MT-05
PE Title: Electronics Manufacturing Budget Activity: 2. Advanced
Technology Technology Development
Date: April 1993

System (TIESS), Gen II Soldier, Soldier Integrated Protective Ensemble (SIPE), Advanced Integrated Man Portable System (AIMS), Advanced Pilotage Capabilities (APA), Covert Night/Day Operations in Rotorcraft (CONDOR), CONDOR Advanced Visionics System (CAVS).

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
May 93	Deliver engineering samples of 1280x1024 monochrome electroluminescent display.
Jun 94	Deliver 1280x1024 monochrome electroluminescent display.
Jul 94	Deliver 640x512 color electroluminescent display and 1280x1024 color liquid crystal display.
Aug 94	Deliver Combat Vehicle Crew prototype helmet.
Jun 95	Demonstrate full color, high resolution helmet mounted displays in virtual environment application.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-07

PE Title: Electronics Manufacturing
Technology

Budget Activity: Advanced Technology
Development

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project Number & Title</u>	<u>FY 1992 Actual</u>	<u>FY 1993 Estimate</u>	<u>FY 1994 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
MT-07	Centers of Excellence (20,000)*	27,665	4,837	Continuing	Continuing

*FOCUS HOPE Program funded in OSD PE 63719D.

B. (U) BRIEF DESCRIPTION OF PROJECT: This project provides funding for three Technology Centers of Excellence: The National Center for Coal Utilization at Pennsylvania State University; Robert C. Byrd Institute for Advanced Manufacturing at Marshall University; and the Focus: Hope Center for Advanced Technologies in Detroit, Michigan. The purpose of these Centers is to demonstrate, deploy and provide advanced manufacturing technology to significantly reduce unit production and life cycle costs, improve product quality, and deploy manufacturing training systems.

(U) The National Center of Excellence for Coal Utilization is a consortium whose purpose is to expand the use of anthracite and bituminous coals.

(U) The Institute for Advanced Flexible Manufacturing Systems provides both a teaching factory and initiatives to local area industries to utilize computer-integrated manufacturing technologies and managerial techniques to improve productivity and competitiveness.

(U) The Center for Advanced Technology is a component of the Focus: Hope Project whose purpose is to train technicians/engineers in advanced manufacturing processes and methods, demonstrate state-of-the-art flexible manufacturing and serve as a testbed for emerging manufacturing research. The three program elements include: development of world-class manufacturing training/education to expand on current programs; development of a world-class flexible computer integrated manufacturing facility supporting education under full-scale production conditions; and development of an aggressive technology outreach program, serving to demonstrate the results of manufacturing research and integration technologies under production conditions, and to serve as a technology transfer activity.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing
Technology

Project Number: MT-07

Budget Activity: Advanced Technology
Development

Date: April 1993

(U) The FY 1994 program provides continued support for the Center for Advanced Technology. These funds will be used to acquire computer integrated manufacturing systems including computers, software, scheduling systems, and statistical process control software.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Completed the installation of three flexible manufacturing neighborhoods including 78 machine tools at the National Center for Advanced Technologies at Focus Hope.
- (U) Completed specification for computer integrated manufacturing system including networked access of advanced computer aided instruction materials, work flow management, statistical process control, computer aided design, and computer aided manufacturing software tools at Focus Hope.

(U) FY 1993 Planned Program:

- (U) Complete staffing of engineering management and dean of education at National Center for Advanced Technology (NCAT).
- (U) Demonstrate full art-to-part capability of automotive parts manufacture.
- (U) Provide manufacturing process support to a regional manufacturer from the Robert C. Byrd Institute for Advanced Technology.
- (U) Complete curriculum development for hands-on production center manufacturing systems training supporting certificate, associates, bachelors and masters degrees.
- (U) Develop further reductions in gaseous and particulate emission when firing coal-based fuels in industrial-scale boilers.
- (U) Prepare and characterize fuels compatible with coal pre-combustors.
- (U) Investigate pre-combustion as a means of using high ash and sulfur coals.

(U) FY 1994 Planned Program:

- (U) Develop contracts, determine manufacturing requirements, purchase and install manufacturing equipment and enter production for the 4th and 5th of eleven planned

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-07

PE Title: Electronics Manufacturing
Technology

Budget Activity: Advanced Technology
Development

Date: April 1993

manufacturing neighborhoods at NCAT increasing overall
defense production rates to 10,000 parts per month.

D. (U) WORK PERFORMED BY: PROJECT: FOCUS HOPE, Detroit, MI; Center of Excellence and Coal Utilization, University Park, PA; and Marshall University, Huntington, WV.

E. (U) RELATED ACTIVITIES: This program augments the Director of Defense Research and Engineering S&T "Thrust 7" technology for affordability. Capabilities that will be deployed to centers of excellence include technologies developed under project #MT-08, Manufacturing Technology Initiatives.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-08

Budget Activity: 2. Advanced Technology Development

Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Manufacturing Technology Initiatives

<u>Popular</u> <u>Name</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
Manufacturing Technology Initiatives	0	0	19,146	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: This program's focus is on process technology demonstrations, providing prototype factories as well as prototype products. Included are the initiation of two Advanced Technology Demonstrations (ATDs) and additional technology base demonstrations of affordable manufacturing processes for composite materials and a prototype networked manufacturing systems infrastructure. The composites manufacturing demonstrations will focus on improving productivity in fabrication of polymer matrix composite structures and assemblies. The networked infrastructure will link computer aided design and manufacturing systems, and will reduce the overhead burden of translators among dissimilar systems.

(U) The two ATDs are Active Electronically Scanned Arrays (AESA), and Flexible Design and Assembly of Missile and Munition Seekers (FDAMMS). AESA will put into place the advanced design and manufacturing capabilities needed to implement enhanced high-rate transmit-receive (T/R) module production and will address the assembly of T/R modules into affordable arrays for radar (military and civilian), electronic warfare and missile applications. FDAMMS will develop and integrate automated design-for-assembly tools, process planning and control systems, advanced factory simulations, and flexible high precision assembly and checkout systems to control the cost of complex electro-mechanical products such as missile and munition seeker assemblies.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Program:

- (U) None. (FY 1994 start)

(U) FY 1993 Planned Program:

- (U) None. (FY 1994 start)

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
PE Title: Electronics Manufacturing
Technology

Project Number: MT-08
Budget Activity: 2. Advanced Technology
Development
Date: April 1993

(U) FY 1994 Planned Program:

- (U) Issue solicitations and make competitive awards for AESA, FDAMMS, manufacturing systems infrastructure prototypes and affordable composites manufacturing
- (U) Initiate program aimed at lowering the cost of polymer matrix composites via improved manufacturing processes.
- (U) Begin development of advanced computer aided design (CAD) tools and enhancements of existing tools for active electronically scanned arrays, missile and munition seekers, and their components.
- (U) Begin development of feature based solid models and object oriented process modeling tools for electronic assemblies (e.g. T/R modules and arrays) and mechanical assemblies (e.g. gimbaled seeker mechanisms).
- (U) Begin development of "flexible factory" simulation and control systems for high volume production of T/R modules and low volume production of seeker assemblies and other electro-mechanical systems.
- (U) Begin AESA development of low cost fabrication and assembly approaches for T/R modules that make use of advanced technologies such as photonic interconnects.
- (U) Begin FDAMMS development of design for assembly tools, flexible manufacturing and assembly processes and equipment, and supporting information infrastructure components.

(U) Program to Completion:

- (U) The program will be completed in FY 1998.
- (U) A prototype flexible factory for fabricating and assembling arrays of required quantities of T/R modules at the lowest possible cost for a wide variety of DoD applications will be fully operational.
- (U) A prototype flexible factory for designing and assembling complex electro-mechanical assemblies will be operational, with demonstrated improvements in the cost, leadtime and quality of missile and munition seeker assemblies.
- (U) The resulting software tools, processes, networked infrastructure and intelligent control systems will be available for application to a wide range of products for both military and civilian applications.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
PE Title: Electronics Manufacturing
Technology

Project Number: MT-08
Budget Activity: 2. Advanced Technology
Development
Date: April 1993

D. (U) WORK PERFORMED BY: In-house work will be performed by U.S. Air Force Wright Laboratory; Naval Air Systems Command; U.S. Naval Research Laboratory; U.S. Army Missile Command; U.S. Army Research Laboratory; and National Institute of Standards and Technology.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: Not applicable.

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: These programs complement ongoing S&T Thrust 7 ATDs in Rapid Prototyping of Application Specific Signal Processors (RASSP), and Infrared Focal Plane Array Flexible Manufacturing (IRFPA-FM). Closely related AESA-precursor work is being undertaken under the ARPA sponsored High Density Microwave Packaging for Next Generation Phased Array Radar Program. These programs are also under program element 0603739E, and are coordinated by the DoD S&T Thrust 7 Technical Planning Team.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Jun 94	Award contracts for computer aided design developments, modeling, fabrication and assembly of advanced T/R modules and missile seekers.
Jun 95	Initial demonstrations and benchmarking of integrated product/process development approach for T/R modules, seeker components and higher level assemblies.
Jun 96	Complete development and alpha test of advanced CAD tools, process planners and simulation models.
Jun 97	Complete flexible factory systems for AESA and FDAMMS. Demonstrate capabilities to meet cost, cycle time and quantity requirements.
Sep 98	Deliver final versions of software and manufacturing equipment and processes, and transfer technology for both military and commercial use.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: ~~40603739E~~

Project Number: MT-10

PE Title: Electronics Manufacturing
Technology

Budget Activity: 2. Advanced

Technology Development

Date: April 1993

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Advanced Lithography

<u>Popular Name</u>	<u>FY 1992 Actual</u>	<u>FY 1993 Estimate</u>	<u>FY 1994 Estimate</u>	<u>To Complete</u>	<u>Total Program</u>
Advanced Lithography	76,000*	71,293*	47,457	Continuing	Continuing

*Funded under PE 0602712E in FY 1993 and prior years

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: Lithography technology has enabled the dramatic growth of integrated circuit (IC) capability over the past two decades. Advances in lithography lead directly to improvements in electronic and computing systems performance in terms of speed, power, weight and reliability. Advanced microelectronics technology is essential for computing, data and signal processing, communications for both civilian and military needs. Specific defense applications include smart weapons, radar, electronic warfare, sensing, communications, command and control, and surveillance. Further improvements in areas such as target recognition, autonomous guided missiles and beam forming for sonar and radar will require microcircuits with smaller features in order to meet the power, weight and volume constraints of these systems.

(U) Current microelectronics manufacturing utilizes 0.5 micron minimum feature sizes. This effort develops subsystems and systems to establish manufacturing capability at 0.18 - 0.1 microns for late 1990s manufacturing. Because the optimal cost-effective lithography approach for these future generations of technology are not known today, this effort balances investment in competing approaches with a strong emphasis on the common crosscutting techniques that will be required. Key developments include mask technology (electron-beam tools for pattern writing, mask fabrication demonstration, mask repair tools, and membranes), improved alignment and overlay techniques, metrology, systems development and integration utilizing various radiation sources (x-ray, electron-beam, ion-beam, and optics), and device demonstrations to establish viability of the developed systems.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-10

PE Title: Electronics Manufacturing
Technology

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Installed the first x-ray point source lithography tool in an industrial lab for evaluation.
- (U) Demonstrated 0.2 micron pattern definition with x-ray point source.
- (U) Fabricated 512K static random access memory (SRAM) chips with x-ray 0.35 micron lithography.
- (U) Demonstrated a new plasma focus head which generates 12 joules of x-rays per pulse.
- (U) Completed mask repair tool for 0.50 micron design rules.
- (U) Demonstrated through modeling and experimental work that proximity x-ray lithography may extend to 0.1 micron features with a mask-wafer gap of > 10 microns.

(U) FY 1993 Planned Program:

- (U) Use x-ray lithography to fabricate 512K SRAM chips with 0.25 micron gate lengths.
- (U) Evaluate diode pumping for the laser plasma x-ray source.
- (U) Develop a multi-shot power supply for the focus plasma x-ray source.
- (U) Complete mask repair tool for masks with 0.25 micron features.
- (U) Release a standard configuration for x-ray masks.
- (U) Initiate efforts in ion-beam and e-beam lithographies, directed at prototype systems for 0.18 micron features.

(U) FY 1994 Planned Program:

- (U) Characterize 193 nm optical lithography tool for IC fabrication with 0.25 micron features.
- (U) Evaluate optics design for ion-beam lithography tool.
- (U) Demonstrate mask writer for 0.25 micron features.
- (U) Deliver masks (both x-ray and phase shift) for 0.35 micron features.
- (U) Demonstrate first diode laser pumped point source x-ray stepper capable of .35 micron design rules.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E Project Number: MT-10
PE Title: Electronics Manufacturing Budget Activity: 2. Advanced
Technology Technology Development
Date: April 1993

(U) Program To Completion:

- (U) Demonstrate a "nanowriter" e-beam tool for writing zone plates with sub-50-nm features.
- (U) Demonstrate prototype projection e-beam lithography.
- (U) Demonstrate repair tool for repair of masks with 0.15 micron features.
- (U) Demonstrate aligner for x-ray lithography for 0.25 micron features.
- (U) Demonstrate stage control for lithography tools with 0.12 micron capability.
- (U) Fabricate devices using soft x-ray reduction techniques.

D. (U) WORK PERFORMED BY: IBM, Essex Junction, VT; Lawrence Berkeley, Berkeley, CA; ETEC, Hayward, CA; University of Wisconsin, Madison, WI; Hampshire, Rochester, NY; ALG, Rockville, MD; Lockheed-Sanders, Nashua, NH; AT&T, Murray Hill, NJ.

E. (U) COMPARISON FY 1993 DESCRIPTIVE SUMMARY: Not applicable.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: Not applicable.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Jun 94	Characterize 193 nm optical lithography tool.
Aug 94	Deliver masks from the Microlithographic Mask Development Program.
Sep 94	Demonstrate diode-pumped, laser plasma source x-ray tool.
Mar 95	Demonstrate a "nanowriter" e-beam tool for writing features at 50 nm.
Jun 95	Demonstrate mask repair tool for masks with 0.15 micron features.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603744E
PE Title: Advanced Simulation

Budget Activity: 2. Advanced
Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
SM-01	ARPA/ARNG Advanced Distributed Simulation				
	0	28,522	9,207	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF ELEMENT: In FY 1992, Congress appropriated funds to the Office of the Secretary of Defense for advanced technology training of National Guard roundout brigades. Based on a recommendation from the Defense Science Board, the Director, Defense Research and Engineering made this effort an Advanced Technology Demonstration in his Science and Technology Thrust 6, Synthetic Environments.

(U) The goal of this program is to achieve a 200-300 percent increase in National Guard training effectiveness through the use of advanced distributed information technologies and innovative training strategies. The intent is to develop and integrate affordable technologies that enable National Guard soldiers to conduct sophisticated training either at the local community armory, or at the soldier's home. The program will capitalize on existing commercial technologies, when possible, and develop advanced technologies with potential dual use, otherwise.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Initiated studies to identify candidate applications and to assess the networking of dissimilar devices.
- (U) Conducted technology assessment studies which identified appropriate technologies.
- (U) Conducted informational and decision briefings to Senior DoD and Service Officials.
- (U) Established Senior Advisory Group.

(U) FY 1993 Planned Program:

- (U) Modify mobile Army Reserve National Guard Simulation Networks (SIMNETs).
- (U) Establish a National Guard Simulation Training Site at Fort Knox, Kentucky.
- (U) Develop an affordable table top staff synchronization trainer.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603744E
PE Title: Advanced Simulation

Budget Activity: 2. Advanced
Technology Development
Date: April 1993

- (U) Initiate development of a reconfigurable ground simulator.
- (U) Develop strategies for distributed training.

(U) FY 1994 Planned Program:

- (U) Continue development of the reconfigurable ground simulator and desk top synchronization trainer.
- (U) Continue development and trial of experimental training programs.
- (U) Continue the development of individual learning technologies and networks (e.g., artificial intelligence tools, virtual reality applications, and authoring tools).
- (U) Establish an instrumented force-on-force test facility in each experimental brigade area.
- (U) Continue program assessment and applications research.

D. (U) WORK PERFORMED BY: Bolt, Baranek, and Newman, Cambridge, MA; Texas Instruments, Houston, TX; DEC Computers, Boston, MA; Silicon Graphics Inc., Sunnyvale, CA; SUN Computers, CA; BDM Corp, Monterey, CA/Fort Knox, KY/Fort Benning, GA/Des Moines, IA; SYSCO, Vienna, VA; and Northwestern University, Chicago, IL. Government developers include the Army Research Institute Field Units in CA, GA, ID, and KY; Naval Postgraduate School, Monterey, CA; and the Institute for Defense Analyses, Alexandria, VA.

E. (U) RELATED ACTIVITIES: Related work is closely coordinated with the Defense Modeling and Simulation Office to ensure that unnecessary duplication does not occur.

- (U) Army: PE 0604715A, Non-Systems Training Devices.
- (U) ARPA: PE 0603226E, Experimental Evaluation of Major Innovative Technologies.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603745E
PE Title: Microelectronics Manufacturing Technology

Project Number: EM-01
Budget Activity: 2. Advanced Technology Development
Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

Project Title: Microelectronics Manufacturing Technology

<u>Popular</u> <u>Name</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
SEMATECH	98,000*	94,845	100,000	Continuing	Continuing

*Funded under PE0603739E in FY 92 and prior years.

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM

CAPABILITIES: The cost-effective capability to manufacture differentiated integrated circuits (ICs) -- i.e., logic, application-specific ICs, microprocessors -- at the state of the art and in any volume with rapid turnaround is vital to the creation of leading-edge information systems. In FY 1993 and beyond, this project is focused on the manufacturing tools and methodologies needed for low-cost, flexible, scalable manufacturing to meet defense and commercial needs. Today's microelectronics manufacturing technology is optimized to produce a single part type in large volumes. This project will combine advances in physical equipment (modular cluster tools with real-time model-based process control, ultraclean infrastructure, and cost-effective lithography) with software advances (fully integrated computer-integrated manufacturing (CIM) systems and modeling and simulation tools for designing processes, tools, and factories) to enable state-of-the-art microelectronics manufacturing facilities capable of producing many part types in any volume at low cost.

(U) The project builds on the prior SEMATECH effort funded in this project as well as the development efforts in the Microelectronics Manufacturing Science and Technology (MMST) contract in PE 0602712E. SEMATECH comprises the companies that supply the majority of the ICs used in defense systems, and it has a proven track record of working with equipment suppliers effectively. Therefore, SEMATECH will be the primary performer, with continued cost sharing from its member companies. In addition, a small portion of the funds in this project will support related longer-term efforts outside of SEMATECH that enhance the overall goal of achieving flexible, scalable semiconductor manufacturing.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Completed transfer of 0.5 micron technology to SEMATECH member companies.
- (U) Demonstrated 0.35 micron unit processes.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603745E

Project Number: EM-01

PE Title: Microelectronics Manufacturing
Technology

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

- (U) Initiated technology development for 0.25 micron unit manufacturing processes.
 - (U) Upgraded SEMATECH fab with tools capable of handling and processing 200 mm diameter wafers.
 - (U) Initiated development of an advanced factory control system based on MMST-developed technologies.
- (U) FY 1993 Planned Program:
- (U) Initiate projects to produce equipment, materials and factory control systems that will enable the manufacture of high-quality 0.25 and 0.18 micron semiconductor devices in low-cost flexible facilities.
 - (U) Establish new technical thrusts in computer modeling and contamination-free manufacturing.
 - (U) Expand development of pollution-preventing, environmentally safe manufacturing processes.
- (U) FY 1994 Planned Program:
- (U) Develop operations models of plasma etch and lithography cell.
 - (U) Develop specifications for key production-grade manufacturing equipment for the 0.18 micron generation.
 - (U) Develop in-process sensors for plasma, implant, rapid-thermal and lithographic processes.
 - (U) Demonstrate mechanical and electrical interface standards for micro- and mini-environments.
 - (U) Demonstrate standard equipment control platform including sensor bus and model-based control algorithms.
- (U) Program to Completion:
- (U) Complete factory specifications for a 0.18 micron factory, including equipment, facilities and methods.
 - (U) Complete the material optimization for low-contaminant robust manufacturing process chambers.
 - (U) Optimize micro- and mini-environments for contamination-free manufacturing.
 - (U) Demonstrate open factory integration platform for wafer fab, assembly, and test.
 - (U) Demonstrate fully automated production, including closed-loop process control.

D. (U) WORK PERFORMED BY: The primary performer is the SEMATECH consortium in Austin, TX.

E. (U) COMPARISON WITH FY 1993 DESCRIPTIVE SUMMARY: Consistent with the FY 1993 Descriptive Summaries.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603745E

Project Number: EM-01

PE Title: Microelectronics Manufacturing
Technology

Budget Activity: 2. Advanced
Technology Development

Date: April 1993

- F. (U) PROGRAM DOCUMENTATION: Not applicable.
- G. (U) RELATED ACTIVITIES: Not applicable.
- H. (U) OTHER APPROPRIATION FUNDS: None.
- I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.
- J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestone</u>
Mar 94	Complete gas monitoring strategy for environmentally safe semiconductor manufacturing.
Dec 94	Develop and transfer unit processes and generic manufacturing methods for integration into production facilities for 0.25µm features.
Dec 94	Demonstrate operation of a distributed manufacturing system enabling incremental refinement and supporting tighter process control.
Dec 95	Develop software tools that reduce overall development cycles through application of modeling and simulation prior to hardware design and development.
Dec 95	Demonstrate the operation of key elements of a fully integrated advance manufacturing system enabling maximum flexibility and rapid response to process modifications.
Dec 96	Develop and transfer unit processes and generic manufacturing methods for integration into production facilities for 0.18 features.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0605898E

Budget Activity: 6. Defensewide

PE Title: Management Headquarters
(R&D)

Mission Support

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
MH-01 Management Headquarters	19,644	22,150	24,005	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element provides funding for the administrative support costs of the Advanced Research Projects Agency (ARPA). This funding provides for the personnel compensation and benefits for civilians as well as costs for building rent, physical and information security, travel, supplies and equipment, communications, printing and reproduction. In addition, funds are included for reimbursing the Military Services for administrative support costs associated with contracts undertaken on the Agency's behalf.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments:

- (U) Funding under this program element in FY 1992 supported management and administration for the RDT&E program assigned to ARPA. The majority of the funds were required for the pay of personnel who operate the Agency. At the end of the year, additional end strength was transferred to ARPA.

(U) FY 1993 Planned Program:

- (U) ARPA will continue the basic management and administrative support efforts for headquarters at approximately the same level as FY 1992. End strength authorization has been increased over FY 1992 to support additional research efforts and the Defense Reinvestment initiative assigned to ARPA.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0605898E

Budget Activity: 6. Defensewide

PE Title: Management Headquarters
(R&D)

Mission Support

Date: April 1993

(U) FY 1994 Planned Program:

- (U) ARPA will continue the management and administrative support efforts for headquarters at approximately the same level as FY 1993. The increased funding reflects annualization of the additional end strength provided in FY 1993.

D. (U) WORK PERFORMED BY: Civilian and military personnel assigned to ARPA and by ARPA agent personnel operating within the Military Services.

E. (U) RELATED ACTIVITIES: Not applicable.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0901600E

Budget Activity: 6. Defensewide

PE Title: Contract Administration/Audit

Mission Support

Date: April 1993

A. (U) RESOURCES: (\$ in Thousands)

<u>Project</u> <u>Number &</u> <u>Title</u>	<u>FY 1992</u> <u>Actual</u>	<u>FY 1993</u> <u>Estimate</u>	<u>FY 1994</u> <u>Estimate</u>	<u>To</u> <u>Complete</u>	<u>Total</u> <u>Program</u>
AA-01 Contract Administration/Audit	-	-	27,873	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF ELEMENT: The FY 1994 budget reflects the portion of the Department's estimate for contract audit and management services that will be incurred as a result of contract awards made in this appropriation. These funds will be used to finance Defense Contract Audit Agency (DCAA) and Defense Contract Management Command (DCMC) services that are performed in support of programs budgeted in this appropriation. This Program Element contains the contract audit/management funds associated with ARPA contracts awarded after FY 1993. Prior contracts will be funded from the FY 1994 O&M Defensewide appropriations.

(U) This represents a change from the budget presentation last year and reflects a Congressional and Departmental initiative to move toward mission budgeting which calls for an improved method of budgeting and justifying resources. The visibility of total costs related to contract awards and administrative requirements is improved in this presentation because support service funding for related contracts is included in this appropriation.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1992 Accomplishments: None.

(U) FY 1993 Planned Program: None.

(U) FY 1994 Planned Program:

- (U) DoD full funding policy for general contract administration support and contract audit management efforts associated with ARPA contracts begins in FY 1994.

D. (U) WORK PERFORMED BY: Defense Contract Management Command and the Defense Contract Audit Agency.

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FY 1994 BUDGET ESTIMATES RDT&E DESCRIPTIVE SUMMARY

Program Element: #0901600E

Budget Activity: 6. Defensewide

PE Title: Contract Administration/Audit

Mission Support

Date: April 1993

- E. (U) RELATED ACTIVITIES: This has been implemented DoD wide.
- F. (U) OTHER APPROPRIATION FUNDS: All O&M/investment accounts.
- G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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